Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

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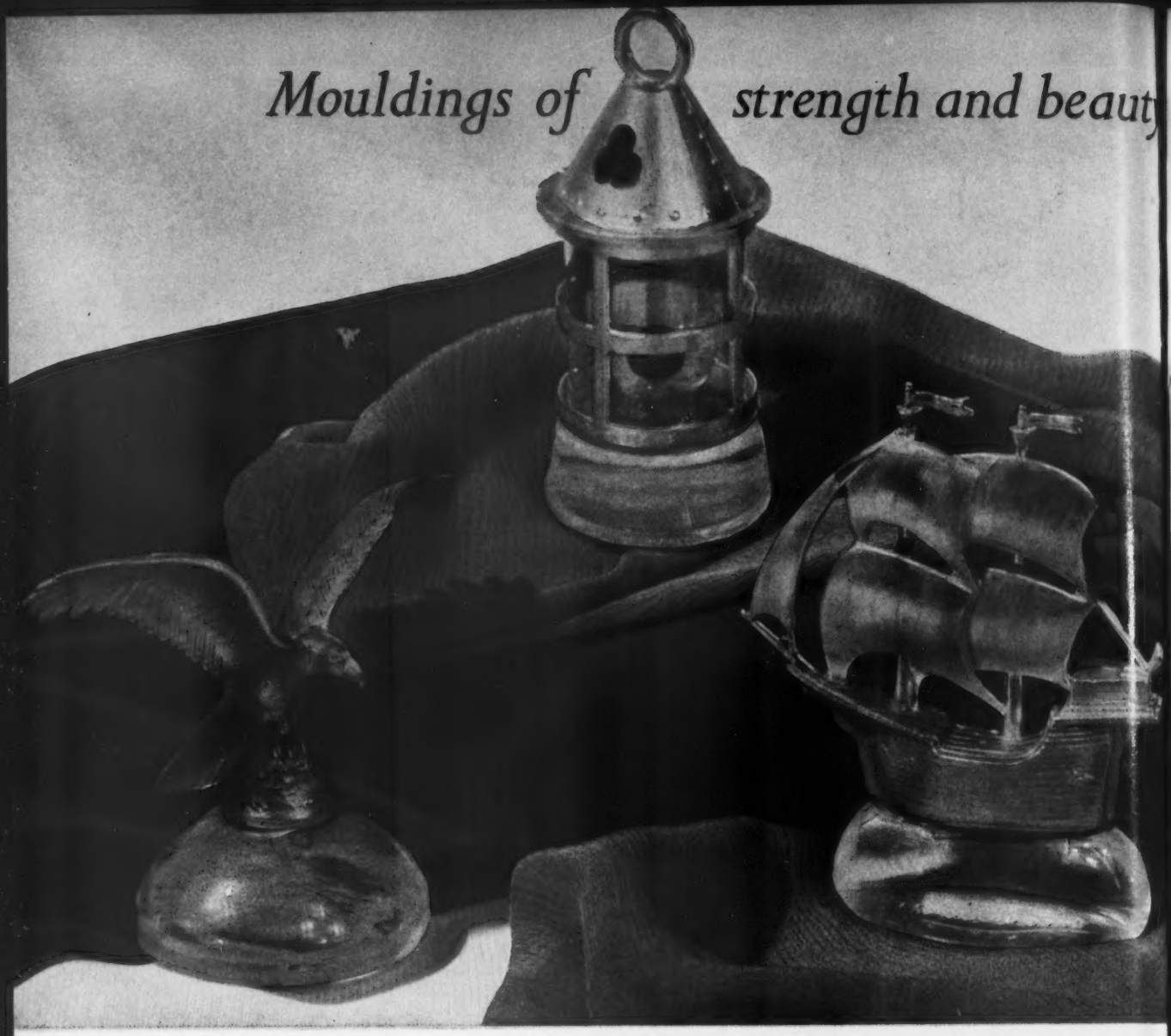
MICANITE & INSULATORS CO. LTD. EMPIRE WORKS, BLACKHORSE LANE, WALTHAMSTOW, LONDON, E.17



Mouldings by Punfield & Barstow (Mouldings) Ltd. for International Glass Bottle Co. Ltd.

BEXOID, the free-flowing cellulose acetate injection material, produces tough mouldings of great strength, and in an unlimited selection of colours. It can be matched to virtually any shade desired: clear, transparent, translucent or opaque, pearl, metallic or tortoise-shell. Easily worked, quickly moulded, and non-splintering, BEXOID is today in constant demand for combs, ornamental jewellery, toothbrushes, toys and many more products, both decorative and practical.

BX PLASTICS LTD.
Higham Station Avenue, London, E.4
Tel: LARkswood 5511

BEXOID

REGD.

Moulding Powder

FOR MOULDING IN THE ELECTRICAL AND ELECTRONICS FIELD

now in bulk production in Britain under licence agreement

PLASKON TYPE ALKYD MOULDING POWDERS

The range comprises

411 PUTTY

417 PUTTY
SELF EXTINGUISHING

420 GRANULAR

422 GRANULAR
SELF EXTINGUISHING

440A Glass Filled
SELF EXTINGUISHING

See it moulded at the British Plastics Exhibition

You will be able to see Alkyd Moulding Powder No. 420 being moulded on a six unit fast closing press, specially developed by Foster Yates & Thom Ltd.

STAND No. 40

RCL

RESINOUS CHEMICALS LIMITED
BLAYDON-ON-TYNE, CO. DURHAM

BUILD YOUR OWN

Plastics manufacturer builds special cooling tower

Stadium Ltd., of Ponders End, Middlesex, plastic mouldings manufacturers, urgently needed a special cooling tower to work in conjunction with plastic injection plant. This picture shows the tower they built for themselves using light alloy Dexion 225; cheap to erect, sturdy in structure, it was tailor-made to meet their needs. This is just one example of the versatility of this economical structural material.

EQUIPMENT—

quickly, cheaply, strongly, *exactly as you want it*—with versatile DEXION slotted angle

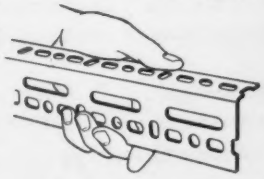
or almost any kind of works or storage equipment you may need — storage racking, machine stands, lleys, work-benches, maintenance platforms, and undred other items — you'll find Dexion Slotted gle the sturdiest, cheapest, most versatile material. Dexion is far easier and quicker to work with than od or angle iron. It merely needs cutting and ting together — no precise measurements or detailed wings, no drilling or welding, no skilled carpentry, painting. *The work has been put into it already*, so t unskilled labour can handle any job. You get ctly the structures you need, without delay, and erally at a big saving.

Dexion is scientifically designed so that every slot l hole has a function, and the remaining metal is where it gives greatest strength. It *tinues* to save you money, because any ion structure can be swiftly altered or mantled and the Dexion used again. ere is no waste, no scrap.

Dexion is the Slotted Angle that started an industry. Now, over 60 million feet are being used by more than 35,000 firms all over the world. *And 80 per cent of Dexion sales are repeat orders.*

GET THE FACTS

Dexion 225 is sold in packets of ten 10-ft. lengths, complete with bolts. Steel Dexion *(price from 1/3½ to 1/5 per foot)* is rust-protected, stove enamelled. Where a light but strong, non-magnetic, non-corroding material is required, use Alloy Dexion (full technical details and prices on request). Dexion Service offers advice or design assistance on any problem, and construction teams are available. Send today for sample piece of Dexion and booklet AB. 131 illustrating uses in many industries. Dexion Ltd., 65 Maygrove Road, London, N.W.6. (Telephone: MAIda Vale 6031-9.)

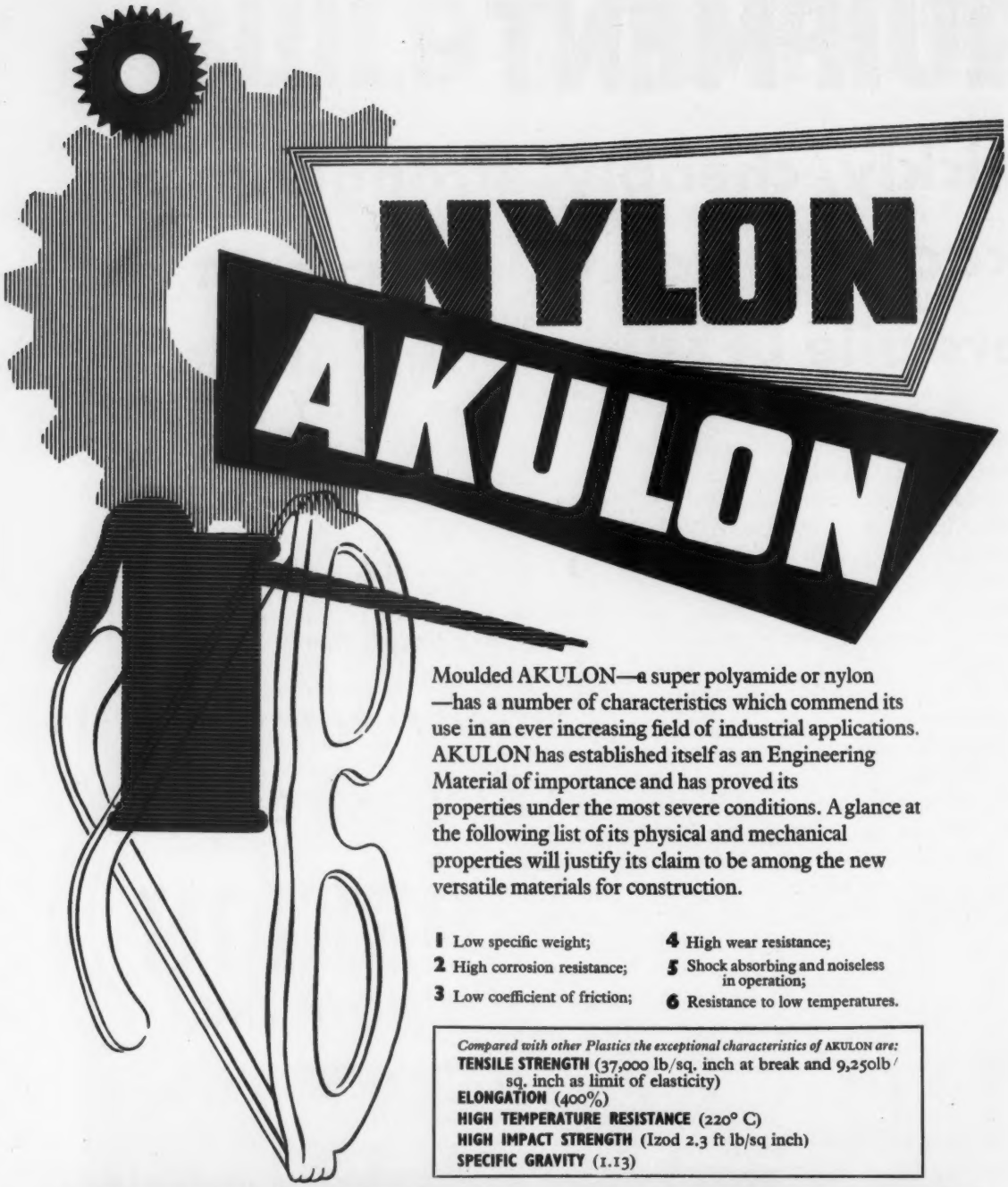


DEXION

SLOTTED ANGLE

ICI solve a problem

Empty drums represent only one of the storage problems that Dexion Slotted Angle helps to solve in industry. This sturdy, inexpensive rack was constructed by ICI Paints Division at their Glasgow works.



Moulded AKULON—a super polyamide or nylon —has a number of characteristics which commend its use in an ever increasing field of industrial applications. AKULON has established itself as an Engineering Material of importance and has proved its properties under the most severe conditions. A glance at the following list of its physical and mechanical properties will justify its claim to be among the new versatile materials for construction.

1 Low specific weight;
2 High corrosion resistance;
3 Low coefficient of friction;
4 High wear resistance;
5 Shock absorbing and noiseless in operation;
6 Resistance to low temperatures.

Compared with other Plastics the exceptional characteristics of AKULON *are:*
TENSILE STRENGTH (37,000 lb/sq. inch at break and 9,250lb/sq. inch as limit of elasticity)
ELONGATION (400%)
HIGH TEMPERATURE RESISTANCE (220° C)
HIGH IMPACT STRENGTH (Izod 2.3 ft lb/sq inch)
SPECIFIC GRAVITY (1.13)

HERCULES POWDER COMPANY, LIMITED

SOLE DISTRIBUTORS FOR THE UNITED KINGDOM
140 PARK LANE · LONDON · W·1
MAYfair 8711 (5 lines)

MANUFACTURED BY
ALGEMENE KUNSTZIJDE UNIE N.V.
ARNHEM · HOLLAND

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55 years of moulding plastics to high precision limits for government and industrial applications at your service

STAND 52
BRITISH PLASTICS
EXHIBITION
OLYMPIA
JUNE 1-11

Moulders to the Admiralty, Air Ministry, Ministry of Supply, Electricity Boards, and world famous undertakings in all branches of British Industry.

Send us your Enquiries

EBONESTOS
INDUSTRIES LIMITED

EXCELSIOR WORKS, ROLLINS STREET, LONDON, S.E.15.

Telephone: New Cross 2080 (20 lines)

Concerning

VINATEX

P.V.C. COMPOUNDS

In general

Vinatex Limited manufacture a complete range of Polyvinyl chloride compounds which can be supplied in the form of chips, slabs or uniform pellets.

In particular

We make compounds for... Petrol resistant extrusions. Non-toxic extrusions. Rigid anti-shatter extrusions. Dielectric, direct insulation and sheathing purposes. High clarity extrusions. General purpose extrusions. Gramophone records.

In addition

We make polyvinyl chloride pastes, "Vinamold" hot melt compounds, "Vinagel" modelling and moulding materials.

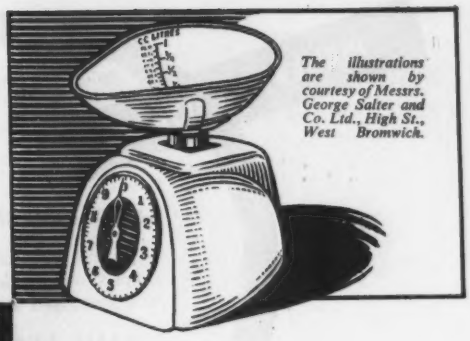
WE INVITE YOUR ENQUIRIES.

VINATEX LIMITED, Devonshire Rd., CARSHALTON, Surrey
Wallington 9282

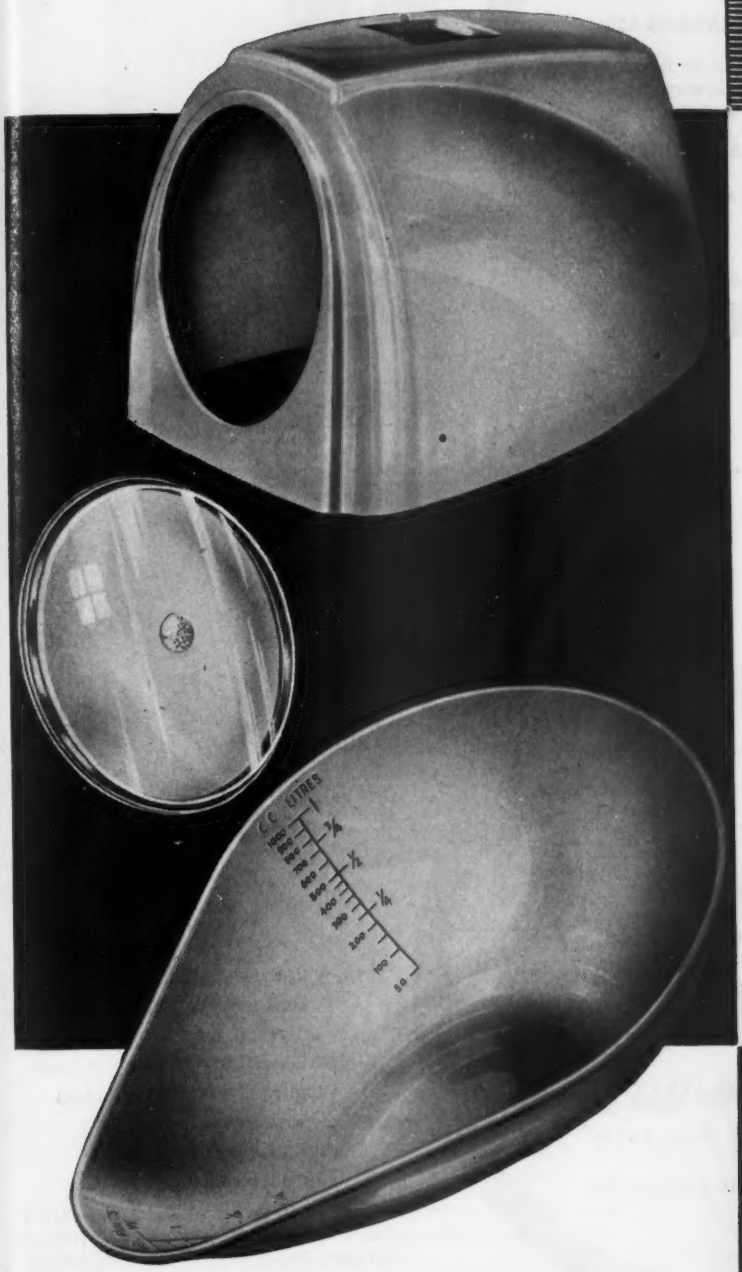
VINATEX LIMITED IS A UNIT OF VINYL PRODUCTS LIMITED

V36

where there's a will —there's a weigh!



The illustrations are shown by courtesy of Messrs. George Salter and Co. Ltd., High St., West Bromwich.



Every moulding presents its own particular problems and this fine, new SALTER kitchen scale was no exception. But where there's a will there's a way and the finished product, which has won the universal approval of housewives, is a tribute to the excellence of Messrs. George Salter's design and a compliment to the precision and finish of our work.

Three separate mouldings were required, a scoop, window and body.

To ensure hard wear high impact Polystyrene was selected for the scoop, on the inside surface of which fluid ounce, pint, cup, c.c. and litre graduations had to be moulded. Clarity and perfect finish and freedom from flow lines were required for the window and the body had to be beautifully finished and dimensionally accurate.

Extreme care in making the moulds and precision and rigid control in moulding, were essential.

The scale is yet another example of what can be achieved when customer and moulder work in harmony.

Little wonder it sells so well. Let us co-operate with you on your next project.

E. Elliott LIMITED

315 SUMMER LANE, BIRMINGHAM, 19 Tel.: Aston Cross 1156-7-8-9

FOUR FACTORIES AT YOUR SERVICE

Walsall Works (Eldon Street)

Victoria Works, Summer Lane

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THE PLASTIC MOULDERS WITH THE ENGINEERING BACKGROUND

PIGMENTING TYPES

BASIC LEAD CARBONATE

—specially prepared for P.V.C. Supplied only as dispersed paste with Plasticisers to choice.

DIBASIC LEAD PHOSPHITE

TRIBASIC LEAD SULPHATE

Stabilisers for P.V.C.

A complete system available for heat, light and dielectric requirements.

TRANSLUCENT TYPES

LEAD SILICATE

DIBASIC LEAD STEARATE

LEAD STEARATE

CADMIUM STEARATE

CALCIUM STEARATE

BARIUM STEARATE

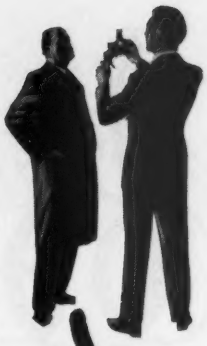
LITHIUM STEARATE

With the exception of White Lead (Basic Lead Carbonate), these Stabiliser/Lubricants are supplied dry, or as non-settling dispersions which facilitate easy mixing and efficient intimate contact with P.V.C.

ASSOCIATED LEAD MANUFACTURERS LIMITED

SPECIAL CHEMICALS DIVISION, CRESCENT HOUSE,
NEWCASTLE UPON TYNE 1, ENGLAND

ASSOCIATED LEAD PRODUCTS



Come and see us at the **BRITISH PLASTICS EXHIBITION**
Stand 32, June 1-11, OLYMPIA

"LET'S CALL IN THE LIVELY LADS AT LORIVAL!"

When it comes to plastics,
enterprising manufacturers leave it to Lorival.
They're lively lads at Lorival.
And they've got what it takes to produce
mouldings of high quality in large quantities
at low prices. Consider the following
facts ... then - call in
Lorival's lively lads!

L57

Plant — Lorival's moulding shop is one of the largest and most modern in the country. Under one roof a complete range of presses moulds practically all the plastic materials.
Tools — Mouldings can't be better than the tools that produce them. Lorival employ many of the finest designers and toolmakers in the business.
Costs — Constant output — Lorival work a three-shifts production of 100 hours a week—lowers costs, speeds delivery.
Clients — Lorival serve many well-known manufacturers, among whom are included Pye, Hotpoint, Ever Ready, Simplex, Skefko and Exide. A longer list would contain leading firms in such fields as textile machinery, motor cars, agricultural machines, instruments, display and packaging, etc.

LORIVAL PLASTICS

UNITED EBONITE AND LORIVAL LTD., LITTLE LEVER, NR. BOLTON, LANCS.

B

It's news!

FIRST AGAIN

Poly-Tainers (Industrial Appliances, Ltd.) announce full scale production of **NYLO-TAINERS** (Regd.) in all sizes and a wide colour range.

Consider these outstanding features:—

- ★ Sterilisation by Autoclaving
- ★ Chemically inert
- ★ Transparent
- ★ Flexible
- ★ Unbreakable
- ★ Lightweight
- ★ Can be permanently printed to individual requirements

Complete Technical Advisory Service at your disposal

Nylo-Tainer Regd.

Enquiries to: **Industrial Appliances Ltd.**
21/22J Grosvenor Street, London, W.1. Tel.: GROsvenor 5976/7/8 (P.B.X.)

Manufactured by: E. Shipton & Co., Ltd., Ferndown Works, Northdown Hills, Middlesex. Tel.: Pinner 1103/5 (P.B.X.)

CHEMICALS BOC DIVISION

introduce the first all-British

P.V.A

Backed by Technical Service

The Chemicals Division of The British Oxygen Company is now able to supply manufacturers with POLYVINYL ACETATE emulsion and POLYVINYL ACETATE granules—the first to be made from all-British raw materials. They are being manufactured under constant quality control in the BOC factory at Chester-le-Street. The BOC Technical Service is ready at all times to help consumers to use BOC PVA to the best possible advantage.

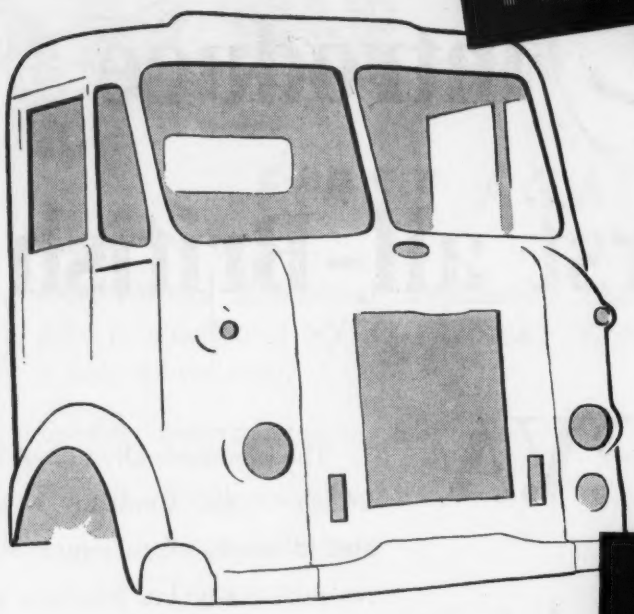
For further information and samples write or telephone to:—

CHEMICALS DIVISION
BRITISH OXYGEN
COMPANY LIMITED

Vigo Lane, Chester-le-Street,
Co. Durham.
Tel: Birtley 145

London Office:
Bridgewater House, Cleveland
Row, St. James's, London, S.W.1.
Tel: Whitehall 9777

Shipshape and Bristol-fashioned in FIBREGLASS



This trim 17-tonner is from the shops of the Bristol Commercial Vehicles Ltd. Ready for the road, it weighs less than 7 tons—a saving of 5 cwt. over earlier versions. Shaped panels, roof and front wings are all moulded of Fibreglass Reinforced Plastic (F.R.P.).

Apart from this Bristol H.G. 8-wheeler, F.R.P. has been used on the Bristol Lodekka double-deck bus. Weight has been reduced appreciably by using Fibreglass Reinforced Plastic for the cab front, corner panels and bonnet top.

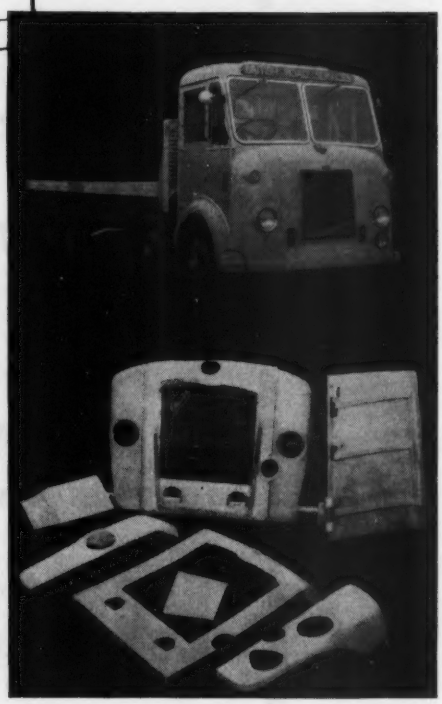
TO ALL CONCERNED WITH TRANSPORT

Fibreglass cuts construction costs and saves time. As the operators are proving, the lessening of weight results in lower running costs. To find out how Fibreglass Reinforced Plastic can help in your form of transport, write to:

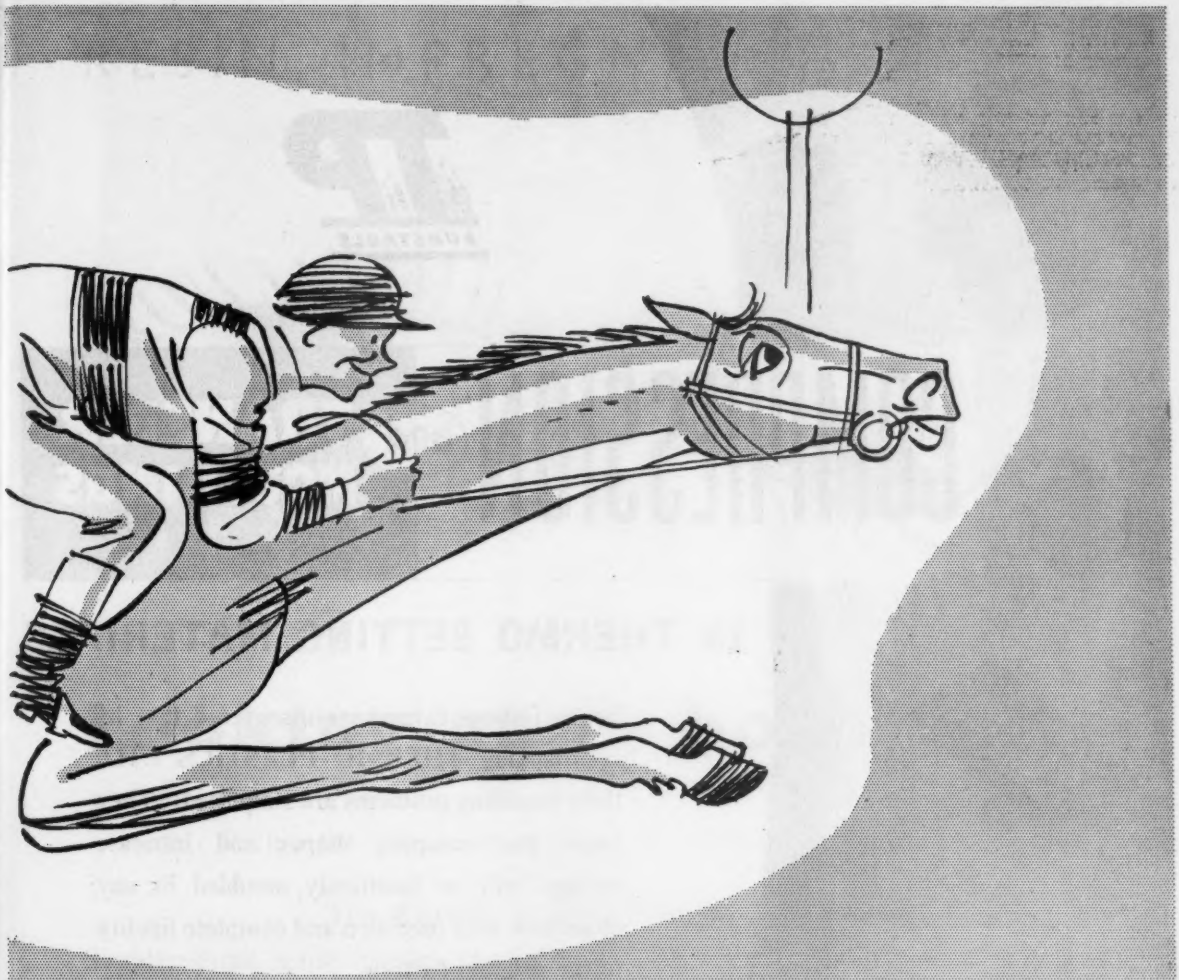
FIBREGLASS LIMITED

RAVENHEAD, ST. HELENS, LANCS. ST. HELENS 4224

FACTORIES AT ST. HELENS, LANCS., AND POSSILPARK, GLASGOW.



(Top) A complete view of the Bristol H.G. 8-wheeler.
(Below) The F.R.P. panels which are used in the Bristol Lodekka bus.



It's the finish that counts

Of course it all depends on what you mean (to quote a Joadism) by finish. But there is no doubt that when it comes to any kind of barrel finishing, Lacrinoid materials win by several lengths.

Readers are invited to send to Lacrinoid Products Ltd., samples of the "work" with which they are concerned. Lacrinoid will investigate the problem by practical tests and will submit a report (without charge) including estimates of the process costs.

LACRINOID BARREL POLISHING **MATERIALS**

"Finer Finishing Faster"

LACRINOID PRODUCTS LTD., GIDEA PARK WORKS, STAFFORD AVE., GIDEA PARK, ESSEX. *Tel:* Hornchurch 2981

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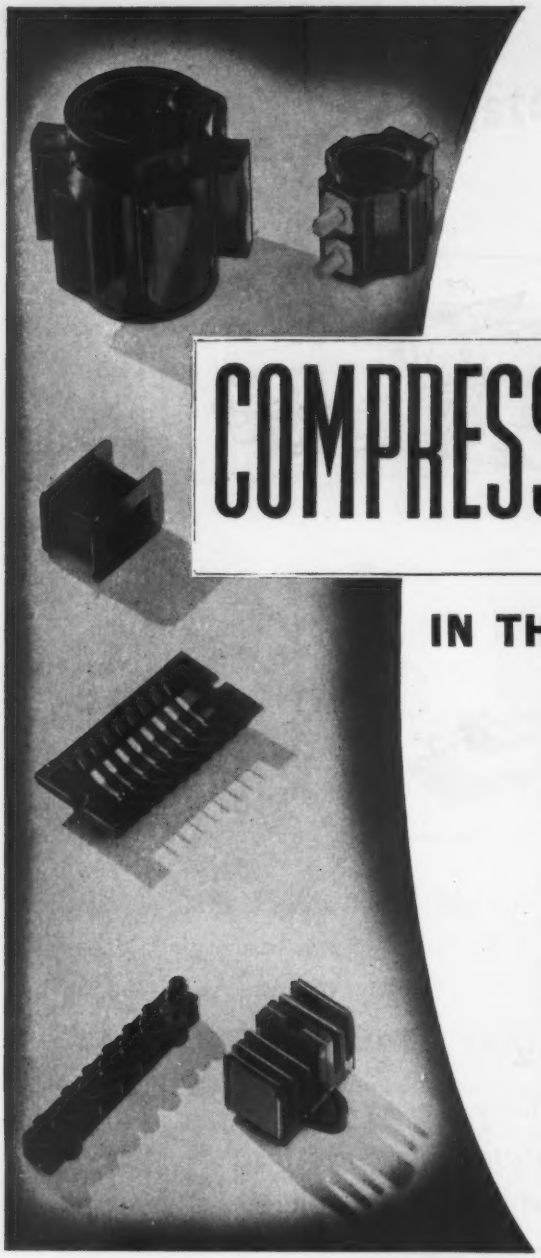

TP DUNSTABLE

COMPRESSION and TRANSFER MOULDINGS

IN THERMO SETTING MATERIALS

Many famous firms have discovered that by approaching THERMO-PLASTICS LTD. their moulding problems are simplified. They know that complex shapes and intricate designs will be faultlessly moulded in any quantities with precision and complete fidelity to the original pattern.

You, too, can entrust your work to Thermo-Plastics Ltd. where production is planned to keep abreast of customers' requirements.

A highly qualified technical staff is at your service.

BRITISH PLASTICS EXHIBITION
JUNE I—II
STAND No. 10

Thermo-Plastics Ltd.

Moulders and fabricators of all plastic materials, including glass and asbestos reinforced laminates, Perspex, P.V.C., Polystyrene, Cellulose Acetate, Polyethylene, Nylon, Phenol - Formaldehyde, Urea - Formaldehyde, etc.

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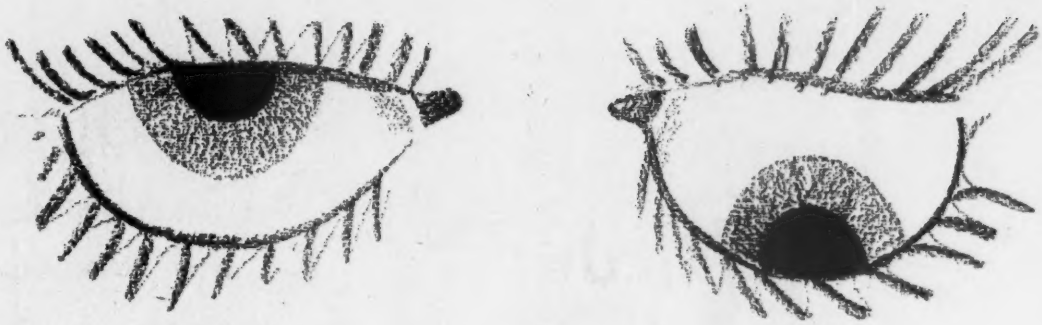
Telephone: DUNSTABLE 1444 (6 lines) *Telegrams:* THERMOPLASTICS, DUNSTABLE

RESIN IMPREGNATED PAPER



Looking at it both ways

Within the Catalin organisation two divisions serve you :—

The Catalin Industrial Resin Division
Supplying the resins needed for you to produce your own impregnated paper.

The Catalin Products Division
Supplying the finished material to your specification.

Whether you do it or we do it, and whether it's for filtration, insulation or for decorative hardwearing finished for modern needs—whichever side of the problem is yours the answer is

Catalin

CATALIN LIMITED
CATALIN PRODUCTS DIVISION
CATALIN INDUSTRIAL RESINS DIVISION
WALTHAM ABBEY · ESSEX
Waltham Cross 3344

Plastic Scrap?

then

sell

it

to

Michael S. Stevens

KESWICK ROAD WORKS, LONDON, S.W.15

VANDYKE 3345-6

BIP at the British Plastics Exhibition

B·I·P presents an outstanding display with a major stand in each section of the exhibition. Here, for the first time in two years can be seen under one roof a truly representative picture of the Group's widespread manufacturing interests and comprehensive service facilities; here seen the impressive results of advances made in quality control of materials, in mould-making and moulding techniques and in plant engineering. B·I·P—the only Group in the industry based on a vertical structure of this scale—cordially invites you to visit the interesting exhibits of its subsidiaries at Olympia:—

B·I·P Chemicals Ltd.
Stand No. 66

B·I·P Engineering Limited
Stand No. 41

The Streetly Manufacturing Co. Ltd.
Stand No. 24

B·I·P Tools Ltd.
Stand No. 55

BRITISH INDUSTRIAL PLASTICS LTD., 1 ARGYLL ST., LONDON, W.1. TEL: GERRARD 7971.

B·I·P

BIP at the British

Special Display o
Structural Plastics..

TEXTILE RESINS · PAPER RESINS · FOUNDRY RESINS · ADHESIV

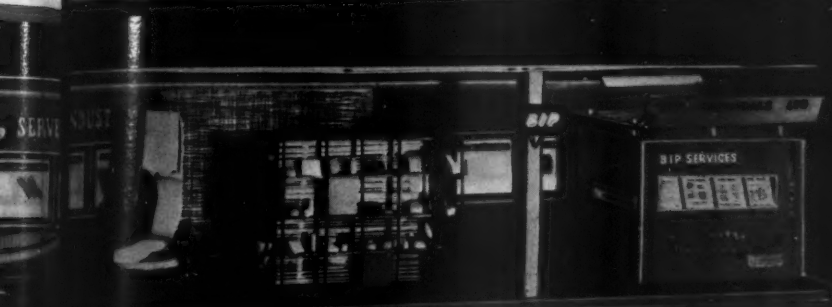
On Stand 66, an outstanding display of structural mouldings made from glass fibr reinforced Beetle Polyester Resins. A new super-quality wood-filled urea mouldi powder, Beetle BW,—which imparts to mouldings a surface finish far in advance of a other wood-filled material. A new foundry resin—Beetle Corebinding Resin W —the lowest priced quality resin corebinder on the market. These are exhibited togeth with the full range of standard amino products, special emphasis being placed Beetle Melamine Resins in surface coating applications.

B. I. P. CHEMICALS LIMITED. Oldbury, Birmingham. Tel: Broadwell 2061

Plastics Exhibition

STAND 66

...and of Mouldings in
Beetle Urea and Melmex (regd.) **Melamine**
Moulding Powders



COATING RESINS · B·I·P SERVICES

This comprehensive display is designed to exemplify the Company's marketing policy—the production of the highest quality, and *only* the highest quality materials at satisfactory prices and backed by unbeatable service. The Service Departments—Research, Development, Technical, and Design—are freely available to assist in development work or the solution of day-to-day problems.

London Office: 1 Argyll Street, London. W.1. Tel: GERrard 7971

B·I·P

B I P at the British P

Stand No 24

Trade Mouldings

An impressive and representative selection of Streetly mouldings in all kinds of thermosetting and thermoplastic materials: here will be found many complex mouldings of special interest to electrical manufacturers as well as the more simple items, and all moulded to the most exacting standards.

B·I·P

THE STREETLY MANUFACTURING COMPANY LIMITED
STREETLY WORKS · SUTTON COLDFIELD TEL: STREETLY 78411

Streetly Melamine Ware

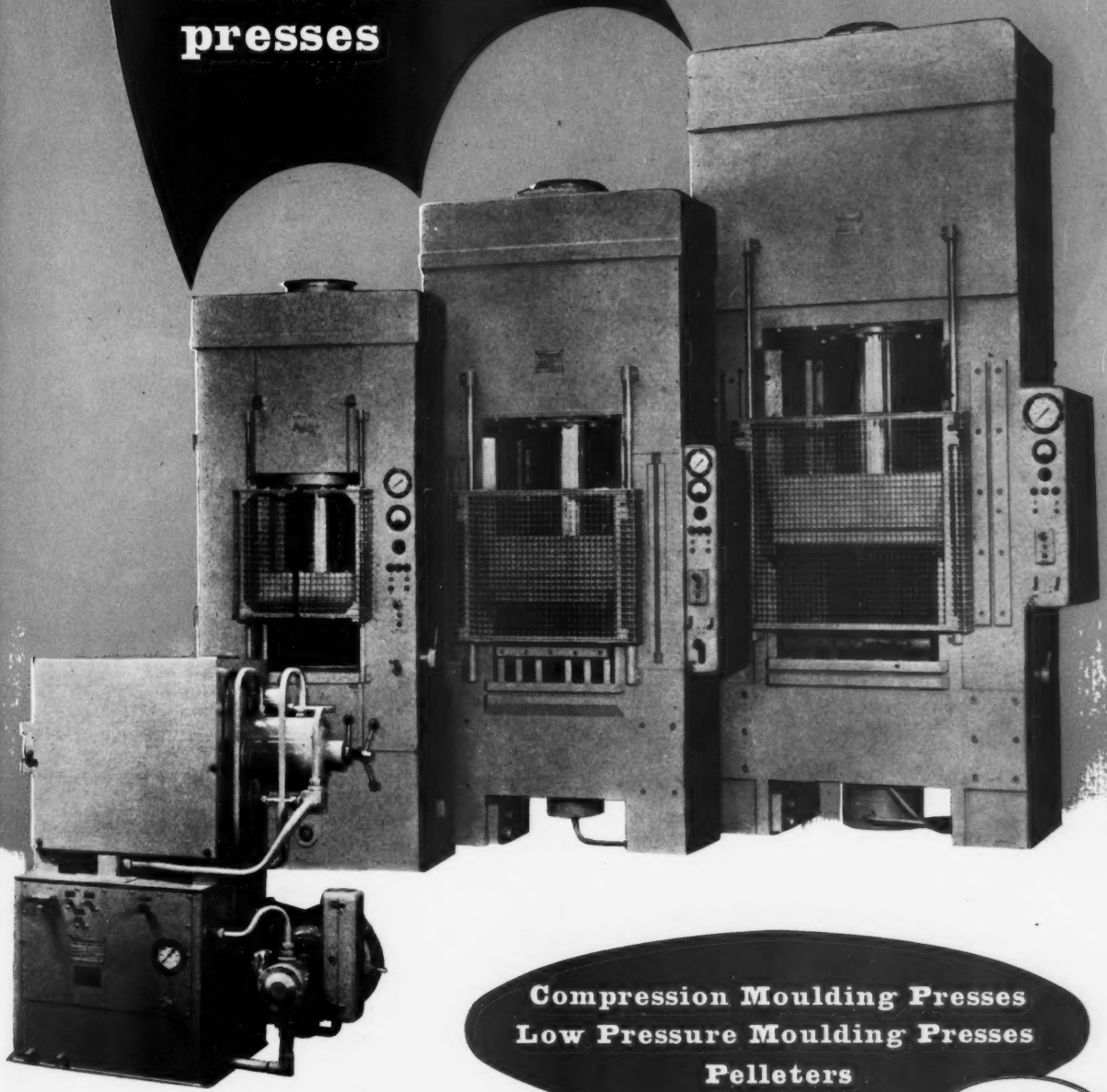
Streetly exhibits its Melamine Ware, made from Melmex melamine moulding powder, and now increasingly in use in hospitals, schools, industrial canteens and catering establishments. Since it was first exhibited two years ago, much has been learnt and embodied in the moulded ware, whilst the range of items has been considerably extended. The display takes the form of an operating tea bar to demonstrate Streetly Melamine Ware in actual use.

Streetly Mouldings

n Plastics Exhibition

see the
BIPEL
family of
auto-control
presses

STAND No 41



Compression Moulding Presses
Low Pressure Moulding Presses
Pelleters

B·I·P

B·I·P Engineering Limited
Streetly Works · Sutton Coldfield

B I P at the British Plastics Exhibition

Meet the Craftsmen of Tyburn Road

Our theme is craftsmanship, for that is the be-all and end-all of our existence; you will find it exemplified in the many fine moulds on display, and evident from the precision and beautiful finish of the mouldings made in them. See, also, our patented induction heating system for built-in, controlled heating of moulds and platens.

B·I·P TOOLS LTD
TYBURN ROAD
ERDINGTON
BIRMINGHAM 24
Tel: Birmingham East 2061

B·I·P

Magic Eye

The product, cine-camera driving motors. The problem, to check the motor speed. But—to check it quickly, accurately, infallibly; with the minimum of mental strain on an operator who is working at high speed. And — a complication: the speed-measuring instrument must not take any power from the camera motor.

The answer? A beam of light: interrupted by the shutter on the camera. The magic eye counts the interruptions, electronic gear translates them into r.p.m.—as a direct reading on a dial. Eureka? But electronic speed measuring is **only one of the many aids to Productivity that electricity can bring you**

Having a hand in Productivity

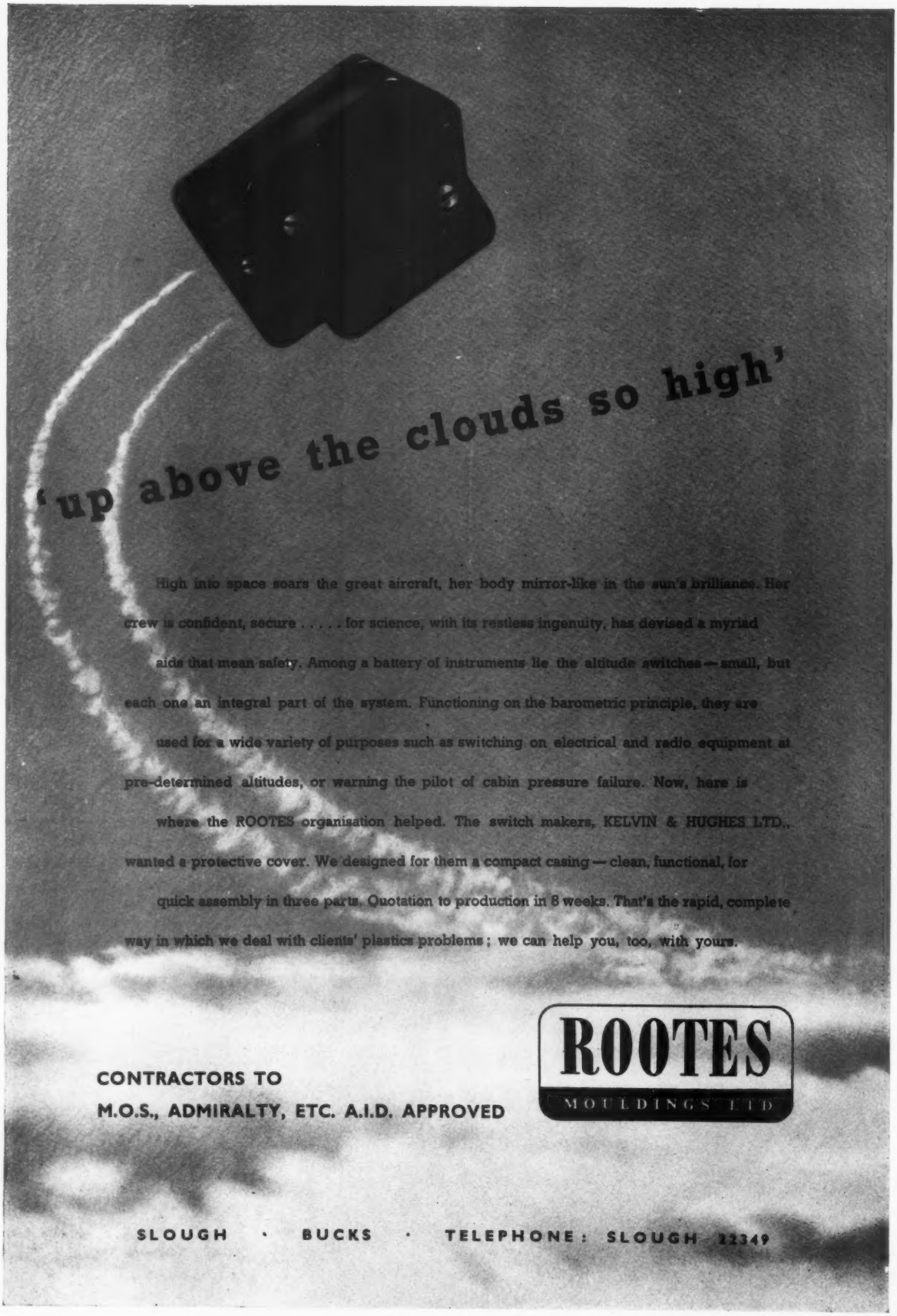
In every industry or trade, electrical equipment is the key to modern production methods. There are probably more production-boosting and money-saving devices than you know of. Your Electricity Board can help you and give you sound advice.

They can also make available to you, on free loan, several films on the uses of electricity in Industry — produced by the Electrical Development Association.

E.D.A. are publishing a series of books on "Electricity and Productivity". Four titles are available at the moment; they deal with Higher Production, Lighting, Materials Handling, and Resistance Heating. The books are 8/6 each (9/- post free) and the Electricity Boards (or E.D.A. themselves) can supply you.

The British Electrical Development Association
2 Savoy Hill, London, W.C.2

Electricity
a Power of Good
for PRODUCTIVITY


'up above the clouds so high'
High into space soars the great aircraft, her body mirror-like in the sun's brilliance. Her crew is confident, secure . . . . . for science, with its restless ingenuity, has devised a myriad aids that mean safety. Among a battery of instruments lie the altitude switches — small, but each one an integral part of the system. Functioning on the barometric principle, they are used for a wide variety of purposes such as switching on electrical and radio equipment at pre-determined altitudes, or warning the pilot of cabin pressure failure. Now, here is where the ROOTES organisation helped. The switch makers, KELVIN & HUGHES LTD., wanted a protective cover. We designed for them a compact casing — clean, functional, for quick assembly in three parts. Quotation to production in 8 weeks. That's the rapid, complete way in which we deal with clients' plastics problems; we can help you, too, with yours.
CONTRACTORS TO
M.O.S., ADMIRALTY, ETC. A.I.D. APPROVED
ROOTES
MOULDINGS LTD
SLOUGH · BUCKS · TELEPHONE: SLOUGH 22349

The manufacturer who looked squarely

at the facts and decided

to use **Epikote Resins**

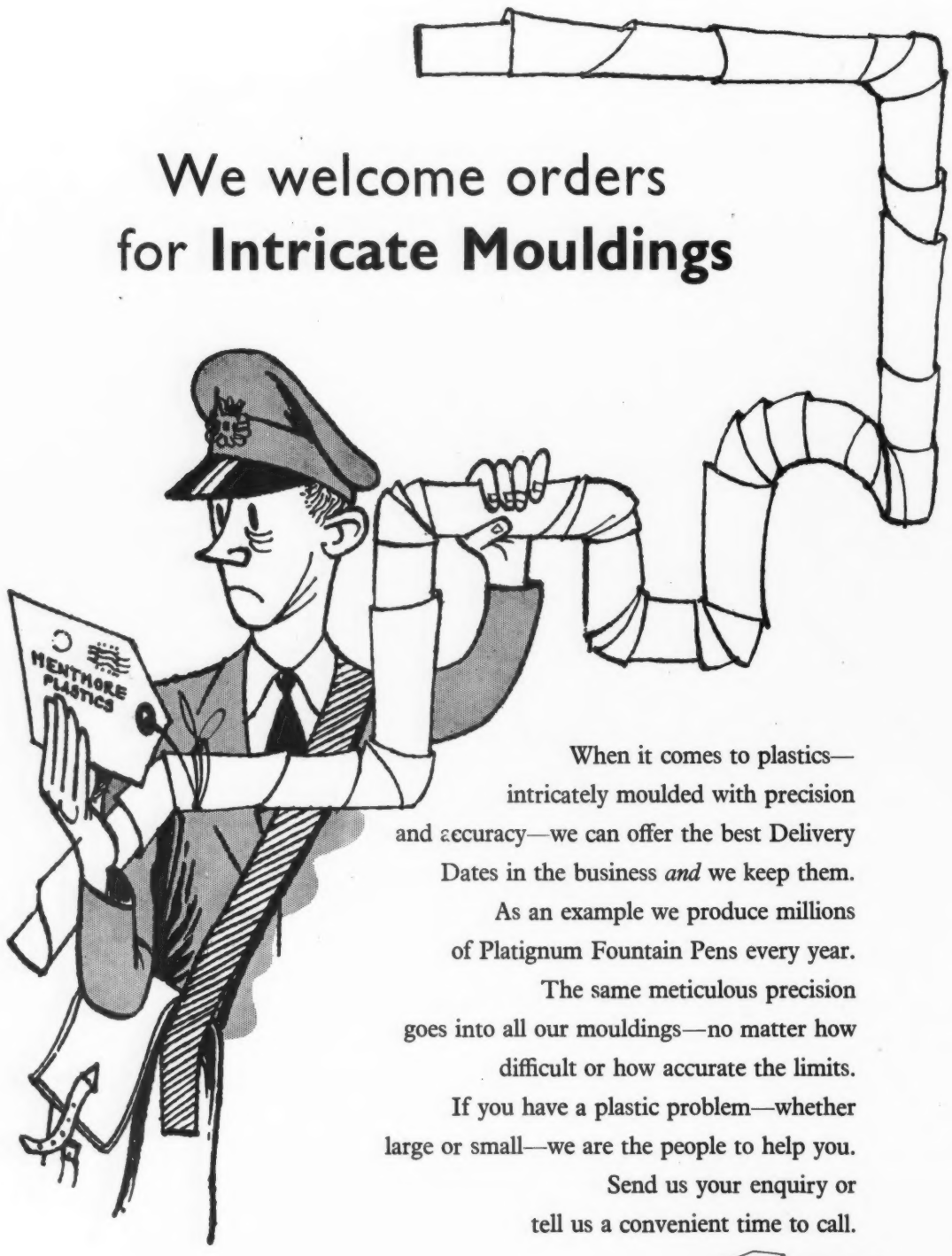
SHELL CHEMICALS LIMITED (DISTRIBUTORS) 105-109 Strand, London, W.C.2. *Tel: Temple Bar 4455*

"EPIKOTE" *is a Registered Trade Mark*

Ep2

D

We welcome orders for **Intricate Mouldings**



When it comes to plastics—
intricately moulded with precision
and accuracy—we can offer the best Delivery
Dates in the business *and* we keep them.
As an example we produce millions
of Platignum Fountain Pens every year.
The same meticulous precision
goes into all our mouldings—no matter how
difficult or how accurate the limits.
If you have a plastic problem—whether
large or small—we are the people to help you.
Send us your enquiry or
tell us a convenient time to call.

we are Mentmore Plastics

MENTMORE MANUFACTURING CO. LTD., 1, BRADLEY ROAD, WOOD GREEN, LONDON, N.22. TEL: BOWES PARK 6021/3

another **Platignum** enterprise

G&G

A pearl effect....

M&B brand
Pearling Agents

... can be achieved in several ways. In plastic material, and especially casein plastics, the most suitable agent for producing a pearl effect is

PEARL PASTE-M&B

Approximately 5% of Pearl Paste —**M&B** in the form of a homogeneous cream, to which the desired dyestuff has been added, is mixed with the dry casein prior to extrusion. It is supplied in 50 kgm. kegs and smaller packs.

PEARL POWDER

This product, as well as Pearl Powder 600A and Pearl Powder 700, is suitable for use with all types of plastics.

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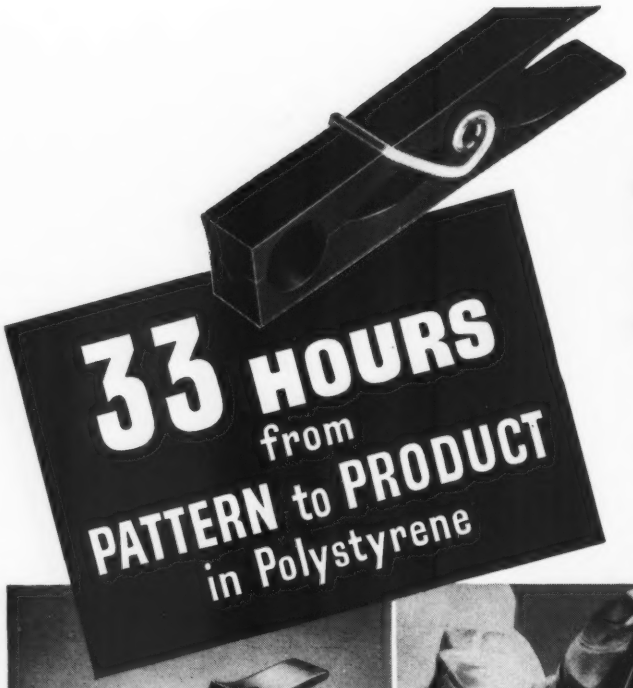
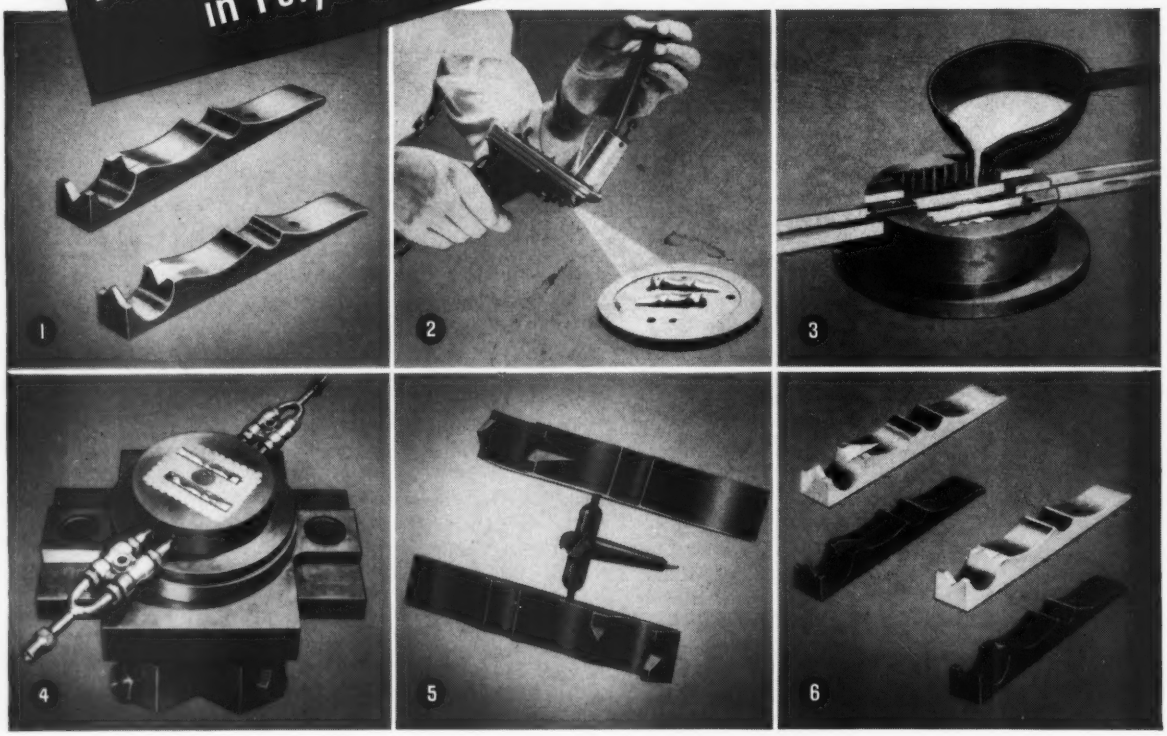
ASSOCIATED HOUSES: BOMBAY · LAGOS · MONTREAL · PORT ELIZABETH · SYDNEY · WELLINGTON · BRANCHES AND AGENTS THROUGHOUT THE WORLD



33 HOURS from PATTERN to PRODUCT in Polystyrene

For the First Time!

By courtesy of Messrs. S. Smith & Sons (England) Limited, we illustrate manufacture of injection mould for production in Polystyrene in a total time of 33 hours and a fraction of cost of machining.



1. Aluminium master pattern.
2. Spraying pattern with Cerrocast.
3. Pouring molten Cerrocast to back sprayed shell and embed water cooling tubes.
4. Complete mould. 5. Typical shot.
6. Comparison of patterns and mouldings.

★ *Technical advice on the selection and application of correct alloy to suit your problem available on request.*

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LOW-TEMPERATURE-MELTING
NON-SHRINKING

Mining and Chemical Products Ltd · 86 Strand London WC2 · Phone Temple Bar 6511/3

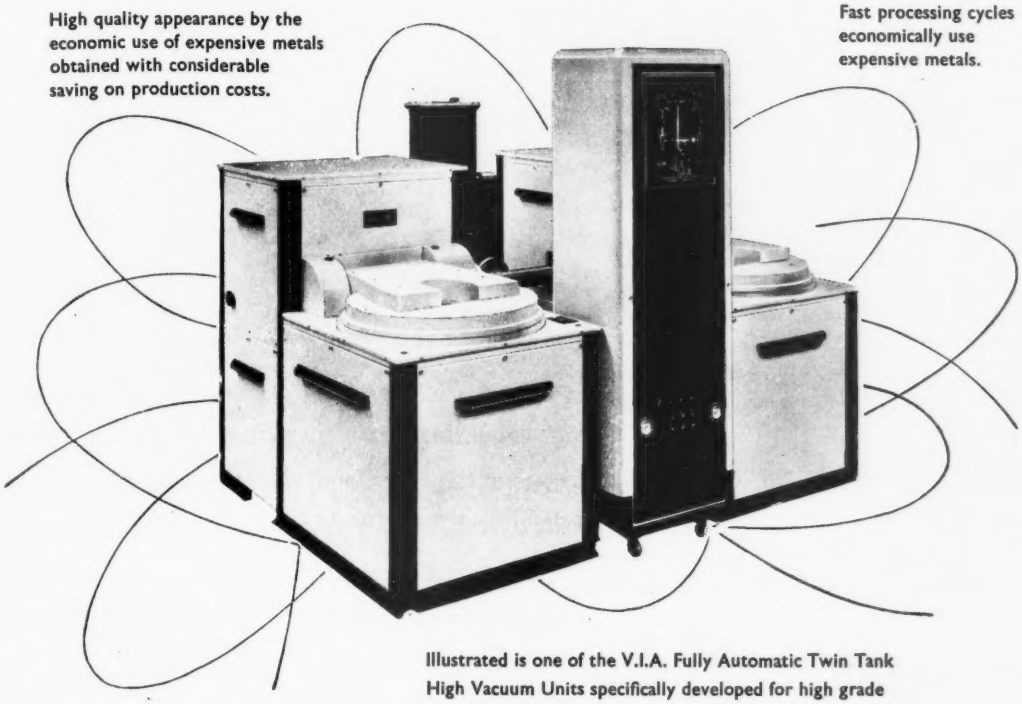
SPECIAL PURPOSE COATING

reflectors processed in

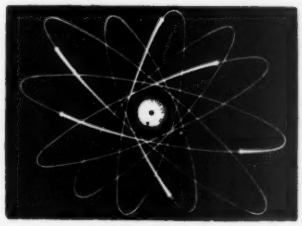
V.I.A. HIGH VACUUM COATING UNIT

High quality appearance by the economic use of expensive metals obtained with considerable saving on production costs.

Fast processing cycles economically use expensive metals.



Illustrated is one of the V.I.A. Fully Automatic Twin Tank High Vacuum Units specifically developed for high grade coating of reflectors, mirrors and similar surfaces. It gives speedy application of fine even films of metals, in single or multiple layers, for large scale economical production.



VIA-VAC

Specialist manufacturers of industrial vacuum equipment—consulting service to industry

VACUUM INDUSTRIAL APPLICATIONS LTD., WISHAW, LANARKSHIRE

G.E.C.

Infra-Red Plastic PRE-HEATING OVEN

Free Trial on your own work

without obligation

Replace old methods of pre-heating and get more from your moulding press by using this modern, inexpensive oven specially designed for pre-heating plastic pellets, powder and flake by radiation from thermostatically controlled heating panels.

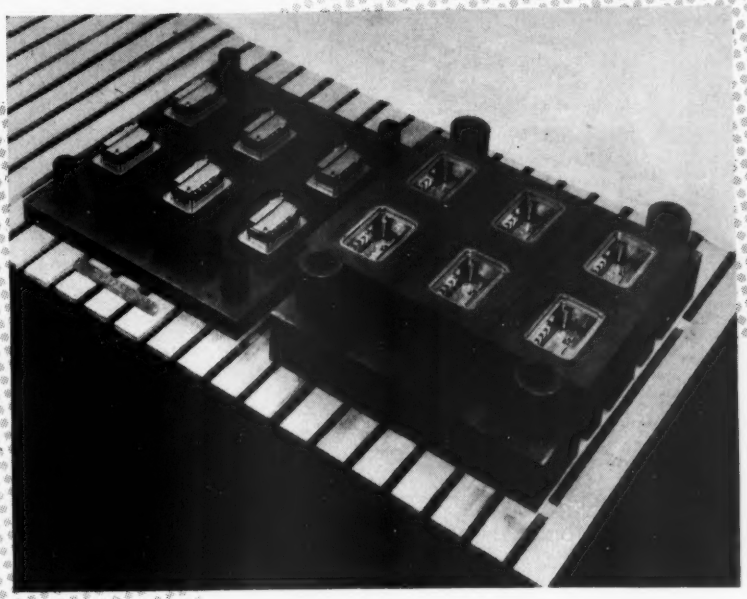
Write for descriptive leaflet PH.126 or ask for a free trial in your own factory.

- *Thermostatic Control of temperatures between 100-280 C.*
- *Easily accommodated close to press*
- *Operates on 200/250 V 50 cps A.C. Supplies or can be arranged for use on D.C. Supplies*
- *Low power consumption List price £48*

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

EDGAR ALLEN

DIE STEELS FOR PLASTIC MOULDS



The six-impression compressor mould, illustrated, is for a connector or junction box, by Minerva Mouldings Ltd., Amersham Common, from Edgar Allen K 9 Steel.

The Edgar Allen range of Die Steels for plastic moulds and hobs covers the whole requirements of plastics manufacturing. The choice of the correct steel, to which we have devoted much attention and intensive research, is a matter needing some experience, and we shall be pleased to advise users.

Meanwhile a great deal of useful information is set out in our Publication No. 41A, which will be sent free on request.

Edgar Allen & Co. Limited
IMPERIAL STEEL WORKS · SHEFFIELD · 9

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Please post data on Die Steels to :—

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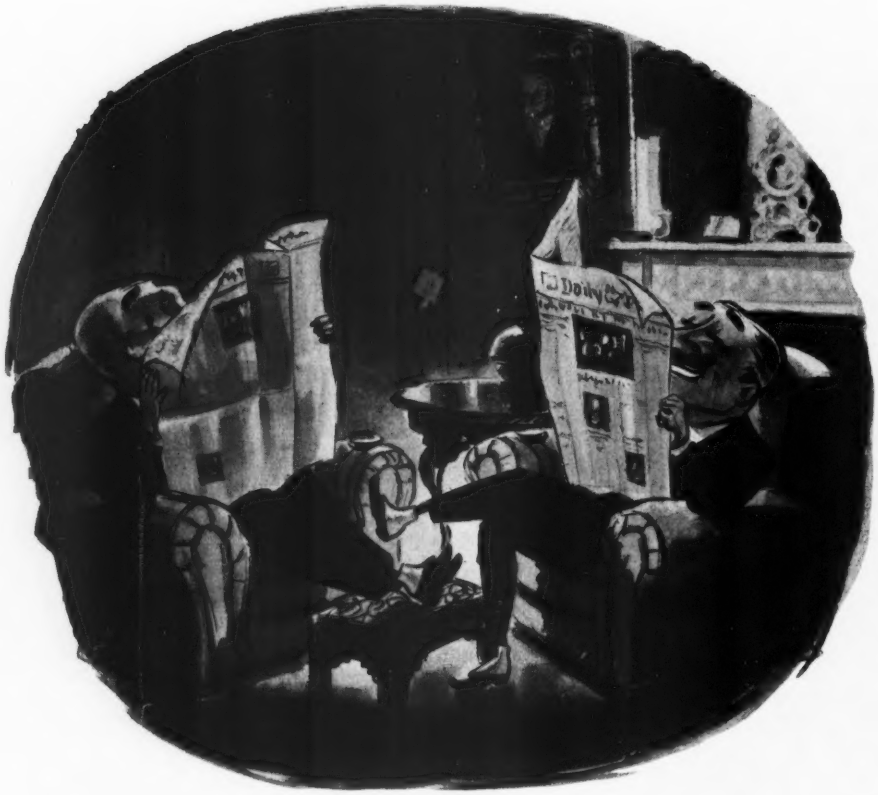

"The news is filtering through, Mr. Ash!"

"I assume you're referring to the new plastic filter plates, Mr. Downs. Would you say that they were made of a specially formulated plastic of a mineral-filled phenolic type?"

"*If necessary, Mr. Ash! What's more, they are less than half the weight of metal plates and, as they are not coated, there are no maintenance costs involved.*"

"Spendid, Mr. Downs! I understand that these plates are exclusively moulded for British Filters Ltd.— and exported in large quantities to the U.S.A. and Canada."

"*Yes, Mr. Ash. They're very much in demand! You see, they won't corrode. They're completely tasteless, odourless and non-toxic—which seems to prove our point that . . . . . .*"

If you want to know what Plastics can do for you—

ask Ashdowns

They'll be at STAND 31 on the ground floor at the British Plastics Exhibition Olympia—from June 1st to 11th

ASHDOWNS LTD., ECCLESTON WORKS, ST. HELENS, LANCS. Telephone: St. Helens 3206. *Ashdowns Ltd. is a subsidiary of Pilkington Brothers Ltd.*

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Now FREE to all!

THE E-M TECHNICAL ADVISORY SERVICE

Regardless of whether your temperature control problem is simple or complex, the fact remains that the only reliable solution is that which entirely eliminates risk.

We therefore respectfully invite you to avail yourself of the wide resources of technical knowledge and practical experience possessed by the specialist technicians of our Temperature Division.

Full technical data and illustrated leaflets promptly forwarded on request!

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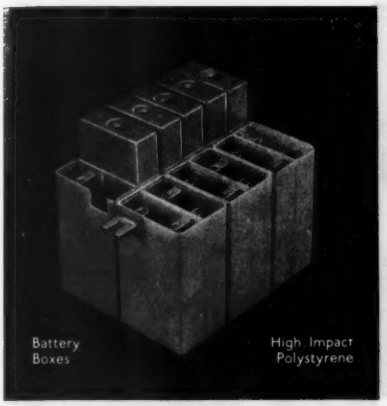
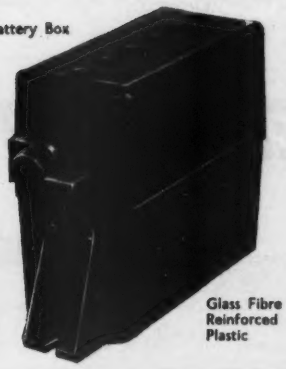
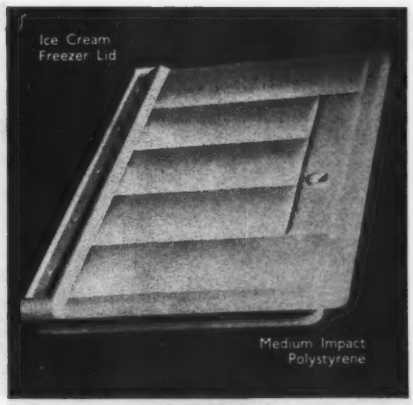


Battery Box



Glass Fibre Reinforced Plastic



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For Tubes and Plastics

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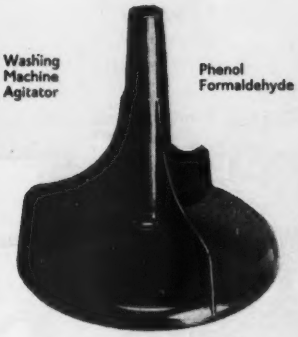
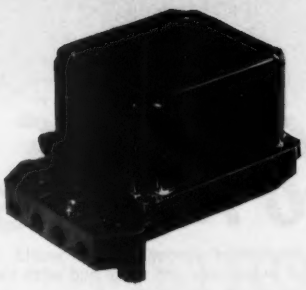
Vacuum Jug — Paper filled and wood filled . urea formaldehyde

Washing Machine Agitator — Phenol Formaldehyde

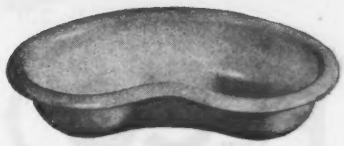




Meter Case in Phenol Formaldehyde

For expert advice and service in Plastics Problems

Discriminating Buyers prefer



Kidney bowl in Melamine

Domes in Diakon

NIVERSAL ETAL RODUCTS TD.

SALFORD 6 LANCS. *Telephone:* PENDLETON 4444

LONDON OFFICE: ARGYLE HOUSE, 29/31. EUSTON ROAD. N.W.1. TEL: TERMINUS 2073

INJECTED or EXTRUDED

PECO MAKE THE MACHINES -THAT DO THE JOB

Illustrated literature is available on all PECO machines and will be gladly sent on request.

Peco Injection Moulding Machinery is now well established throughout the world as equipment in which the best engineering skill and experience are combined with the latest developments in Plastic technology.
A recent addition to the PECO range of machines for the Plastics Industry is the 2½" Universal Extrusion Machine which is illustrated above. This machine aroused much interest at the 1953 Plastics Exhibition in London.

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Enquiries to :

PECO MACHINERY SALES (Westminster) LTD.

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. . . *with their team*

of specialists, skilled in every modern precision technique, backed by the most up-to-date plant, offer you a service famed for its promptness, helpfulness, and efficiency . . . and are *undoubtedly* the firm to turn to in any difficulty involving design or manufacture of Thermo-setting Plastic components.

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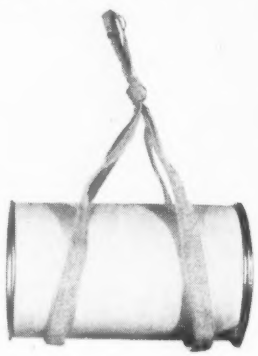
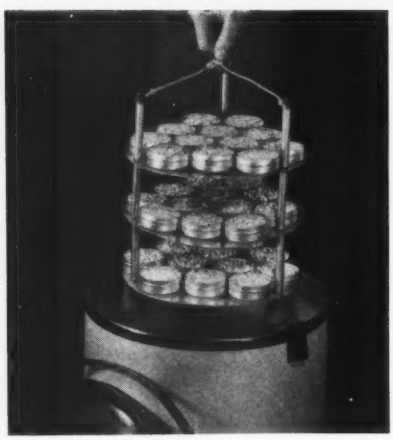
CERTIFIED ZINC ALLOY ZAMCA DIE CASTERS

A.I.D. Approved Factory

BOWATERS PACKAGIN

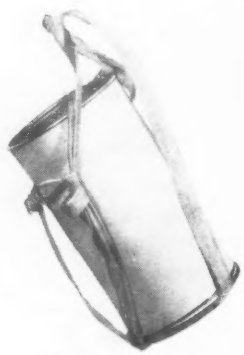
Bowater packaging is closely geared to manufacturers' needs. Its target : to give best protection at lowest cost and, in the retail market, to enhance sales appeal on shelf and counter. Whether you deal with commodities in bulk or individually packed consumer goods, you are likely to find an answer to your packaging problem in the wide Bowater range.





The best way to decide the relative merits of moisture vapour barriers is to expose drums in which they have been incorporated to controlled conditions of humidity. The dishes will be weighed at intervals to determine both the amount and rate of moisture vapour penetration.

This drum, complete with barrier, has been in the humidity cabinet for three weeks. Twenty-one days of damp, steamy, tropical heat. That's the sort of testing the Supakask gets – the sort of testing that leads to better packaging.



Full load drop tests – on top and bottom, on the sides, at angles – simulate the hardest knocks a drum might have to take on its travels. And the Supakask stands up to this kind of treatment.

Man and Supakask

TYPICAL OF BOWATERS' thorough approach to all aspects of packaging is the story of the new Bowater Supakask. This tough, fibre-and-steel newcomer is going places in solving problems of heavy-duty export packing.

It has, of course, been put through vigorous paces down at the Bowater Central Research Laboratory at Northfleet. For example, it was banged, buffeted and generally knocked about to simulate the rough handling it might have to meet on the way to its destination.

Other experiments have also been made. Experiments, for example, with a variety of barrier materials – barriers against water, moisture vapour, chemical contamination – to widen the scope of this remarkable new drum.

The thoroughness with which this experimental and testing work is carried out guarantees the effectiveness of the package in use.

Testing Supakask materials for water vapour permeability. Here a specimen of kraft liner is being sealed over a dish containing a hygroscopic powder. Exposure in a humidity cabinet and periodic weighing indicates the W.V.P. of the material.

ULLETIN

Multiwall reasons why

THE POPULARITY OF Bowaters multiwall sacks grows and grows. Cheap, hygienic and non-returnable they can be used for the bulk packaging of almost every kind of powdered, granular and crystalline substance. New developments include the incorporation of different protective plies to widen the range of this already versatile commodity carrier.

But the basic reasons for the popularity of these sacks remain the same. Note these pictured points of advantage:

(a) Just the right number and type of plies to make sure of adequate protection, hence lowest packaging costs.

(b) Ideally suited for use with modern high-speed packing machinery (from Bowaters, too).

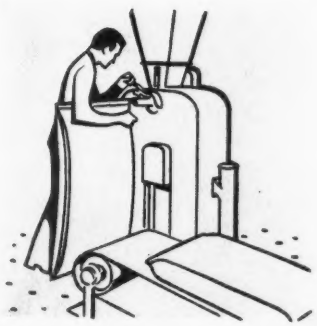
(c) Suited, too, for mechanical handling methods and economical of storage space.

(d) The printed design provides a travelling advertisement for your product.

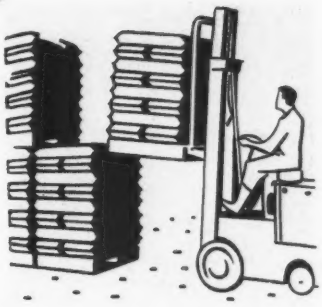
(e) Complete protection from contamination, no wastage through sifting and clean shooting of every particle.

If you could use a pack with these advantages, Bowaters multiwall sack men are ready to talk facts and figures.

(a) Plies right



(b) Speedy packing



(c) Stack easy

(d) Name publicity

(e) Safe arrival

FIBRE DRUMS · MULTIWALL SACKS
PROTECTIVE PACKAGING PAPERS
CORRUGATED CASES · PAPER AND FILM BAGS

Should you require information about, advice on or supplies of any of these Bowater Packaging Products, please write to:

Divisional Sales Manager, Packaging Division
Bowater House, Stratton Street, London, W.1
GRO: 4161

to catch

your eye . . .

. . . to turn your mind to the thought of safety. A good enough reason, perhaps, for linking the well-known beacon with our pigments—but we've a better yet! Matthey cadmium pigments are in fact employed to colour the orange globes so familiar to you today. In this application, as in so many others, they are chosen because of their unique stability, their powers of resistance to the most exacting conditions of manufacture or of use.

Matthey
CADMIUM PIGMENTS

Literature describing Matthey Cadmium pigments is available on request and enquiries on any colouring problem are welcomed.

Johnson Matthey

JOHNSON, MATTHEY & CO. LIMITED, HATTON GARDEN, LONDON, E.C.1. Phone: HOLborn 6989

IN THE SERVICE OF YOUR INDUSTRY

. . . with a range of products including . . .

Phenol · Maleic Anhydride · Phthalic Anhydride · Para Cresol · Meta Cresol · Aroclors* · Lustrex* · Phthalate Esters · Lustrex Latices (*Registered Trade Marks)

We are agents for Monsanto Chemical Company, U.S.A., and can arrange for the importation of chemicals from their range including . . . Santicizer B16—non-toxic plasticizer for P.V.C. and other resins, Santicizer 141—non-toxic non-inflammable plasticizer for P.V.C. and other resins.

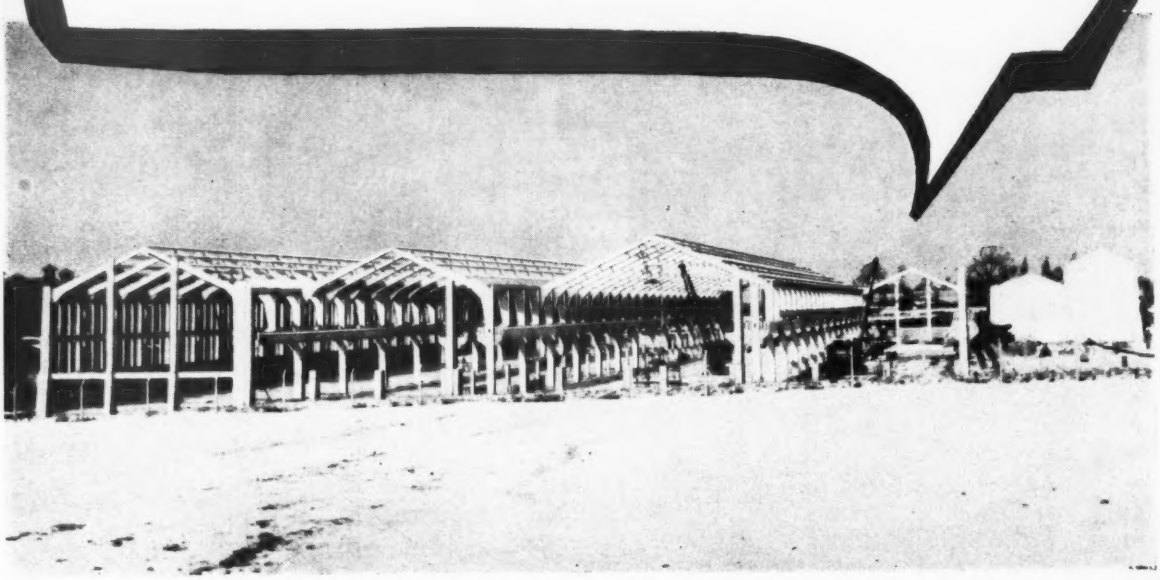
Write for full details to Monsanto Chemicals Limited
152 *Victoria Station House, Victoria Street, London, S.W.1*

MONSANTO CHEMICALS LIMITED
Victoria Station House, Victoria Street, London, S.W.1

MONSANTO

A GUARANTEE has been given by Beecham Buildings Ltd. to complete a new factory of 200,000 sq. ft. and considerable intricate ancilliary work for an Industrial Organisation in the Midlands—within a year.

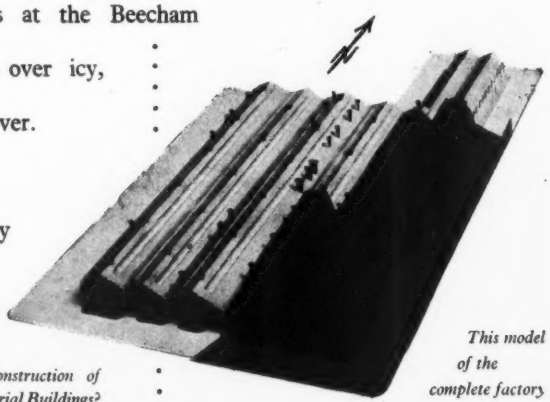
This is the fifth advertisement telling the story.



Even that winter couldn't stop us!

This contract has been carried through the severest winter for many years; and it will still be completed on time. Snow, rain, mists and long periods of intense cold have not stopped the continued daily production of 6 or 7 ton components at the Beecham Buildings factory. These have then been transported over icy, frozen roads to the site where the building teams take over. Even the winter has not put us behind schedule.

Further advertisements will continue to tell the story of this contract and to prove the value of our guarantee.



This model of the complete factory will pin-point progress in the advertisements which follow. Progress to date includes 120,000 cubic yards of excavation; perimeter roads, North extension, foundations complete, floors 80% complete.

Beecham Buildings

May we advise you on the construction of permanent and competitive Industrial Buildings?

BEECHAM BUILDINGS LTD
DEPT. K

SHIPSTON-ON-STOUR, WARWICKSHIRE
Telephone: Shipston-on-Stour 315, 316 & 3287

AP.211.45

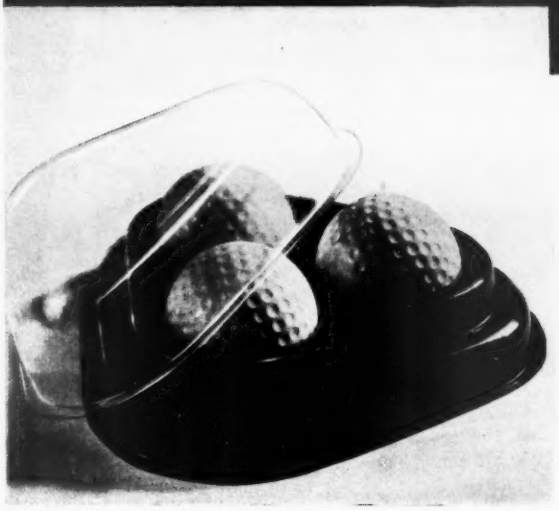
★ Six reasons why

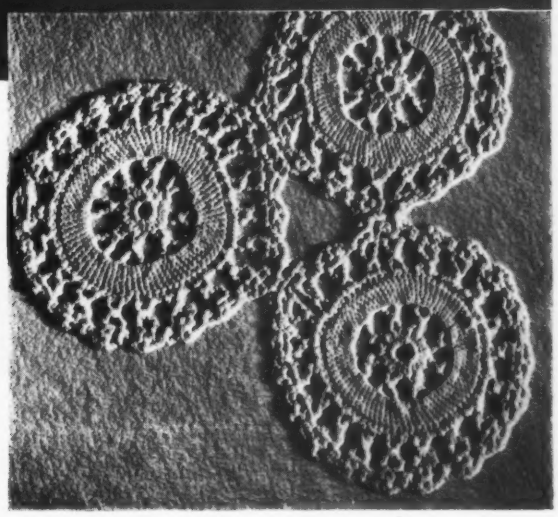
'Cellastine'

TRADE MARK

Acetate Sheeting

for Vacuum forming





★ For finest possible reproduction of detail.

★ Generous depth of draw.

★ High lustre finish.

★ Wide choice of colours: transparents and clear.

★ Faster time cycle giving increased production.

★ Fast action solvent seal.

'Cellastine' acetate sheeting is obtainable in rolls 26" wide (5/1000" — 20/1000") or sheets 56" × 26" (up to 40/1000")

Demonstration of Vacuum forming with 'Cellastine' can be arranged by appointment. Come and discuss your problems of equipment mould design etc.

BRITISH CELANESE LIMITED

Plastics Division, Celanese House, Hanover Square, London, W.1

Erinoid

POLYSTYRENE COPOLYMER GRADE CP.20

Erinoid toughened polystyrene copolymer, grade CP.20, is not only a high impact material, but also has additional outstanding and important properties

the all-round toughened material

High elongation at break
High flexural strength
Moulds easily with a uniform high gloss
Available in heat-resistant quality
Highly suitable for extrusion and vacuum forming
Nineteen standard colours
Available as moulding powder, sheet and extruded sections

Erinoid CP.20 is manufactured by

STYRENE PRODUCTS LIMITED

Full information, samples, prices etc., on application to

ERINOID LIMITED · STROUD · GLOUCESTERSHIRE

Telephone: Stroud 810

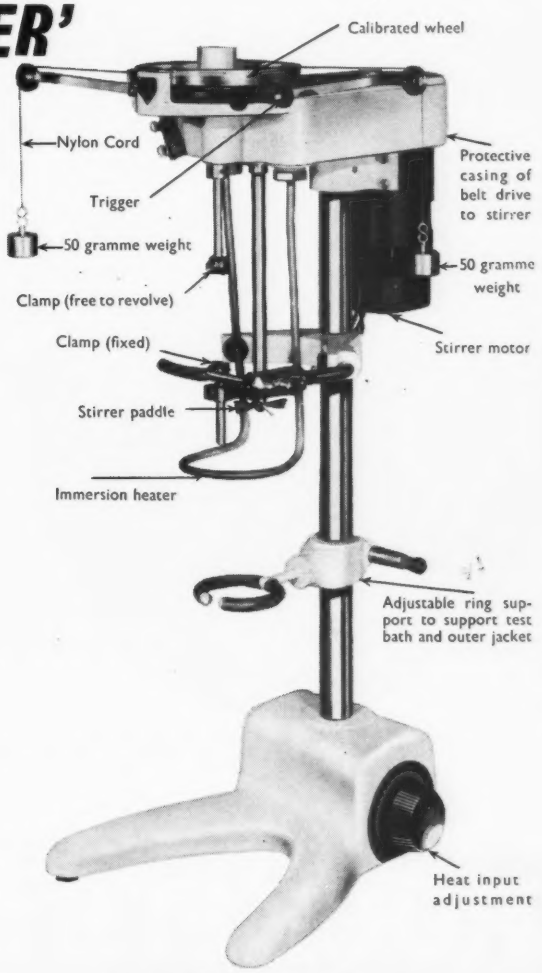
London Offices: 96 Piccadilly · London · W1 Telephone: GROsvenor 7111

B.T.L. INSTRUMENT INFORMATION

B.T.L. 'ELASTOMETER'

For testing the low temperature flexibility of plasticized materials

- The apparatus, originally designed by Clash & Berg of America, measures the angular rotation of a specimen, of standard dimensions, under a constant torque at temperatures between $-70^{\circ}C$ and $+40^{\circ}C$.
- The specimen, held in a clamp, the lower end of which is fixed and the upper end free to rotate under the application of constant torque, is immersed in a mixture of industrial spirit and solid CO_2.
- Torque is applied by two 50 g. weights, acting through nylon cords on a horizontal wheel, calibrated in degrees of arc.
- The wheel is released by a simple hand operated trigger, thus allowing the weights to exert the necessary torque. At the end of the stipulated 5 secs. period the trigger mechanism secures the wheel again and the degree of rotation can be read directly on the scale.
- A 500 watt immersion heater raises the temperature at a rate of approximately 2° C per minute. Heat input may be adjusted by the energy regulator on the base of the stand.
- The stirrer is operated by an encased belt drive from an offset motor to prevent the low temperatures harming motor or belt.
- Test bath and outer jacket are carried on an adjustable ring support, which may be lowered clear of the clamps for ease of assembly.



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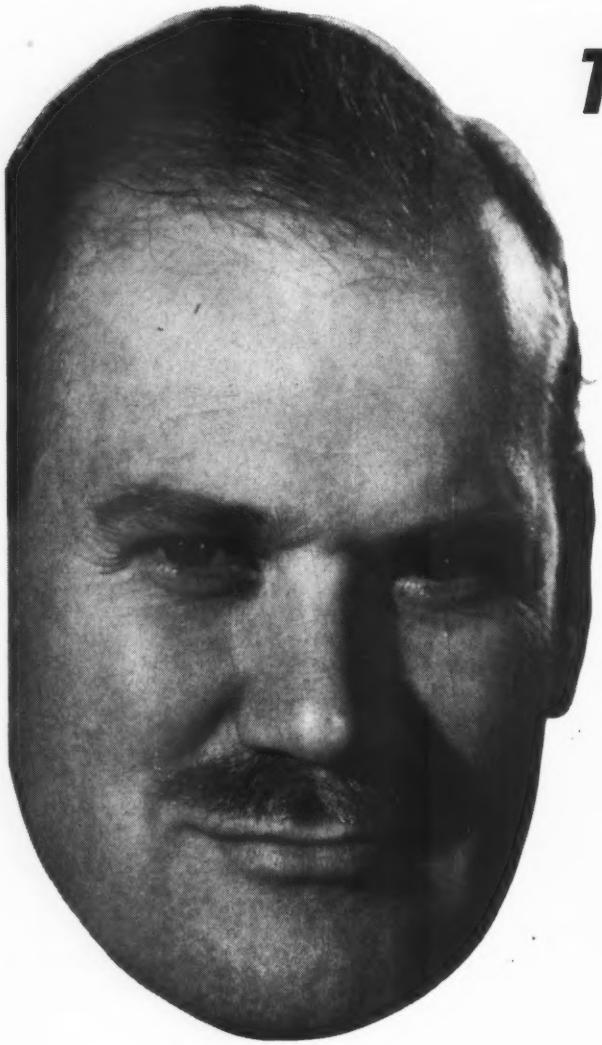

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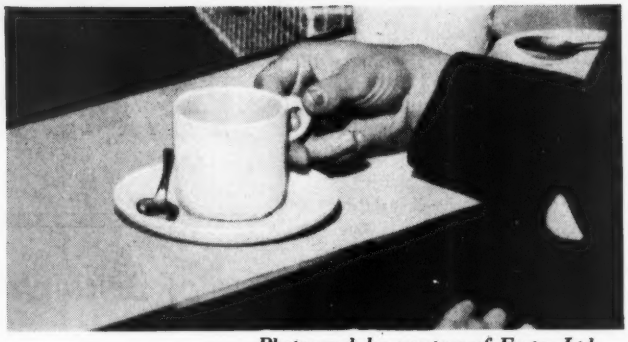

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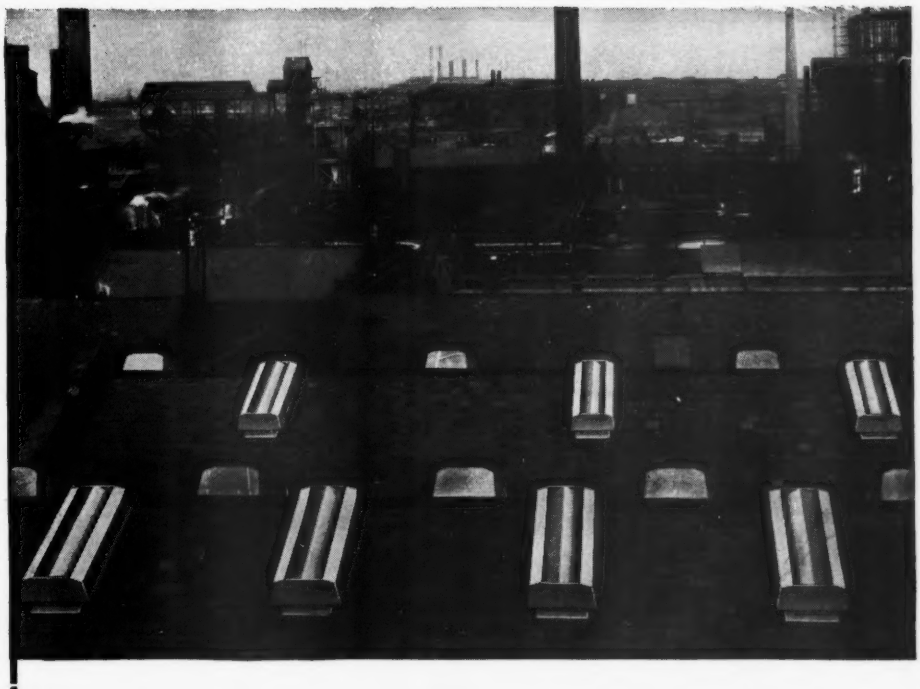

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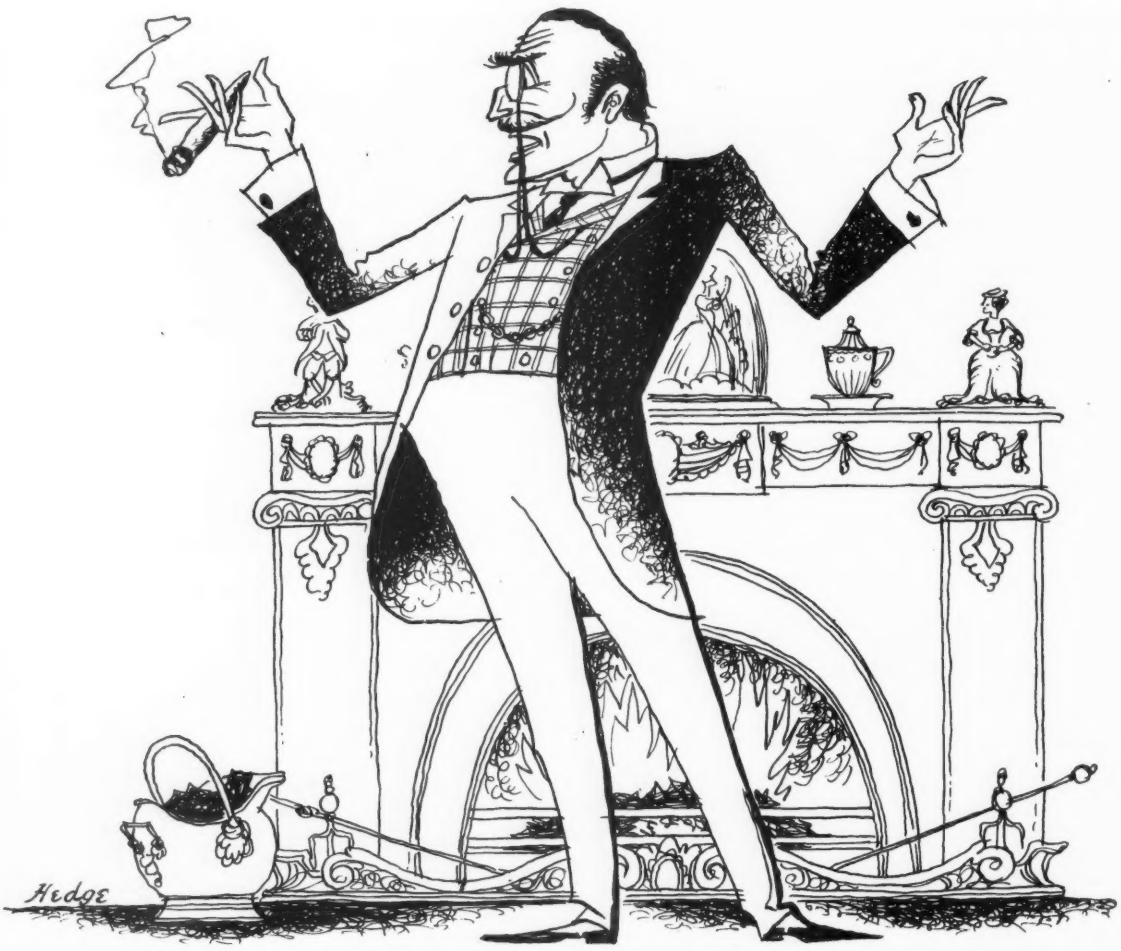

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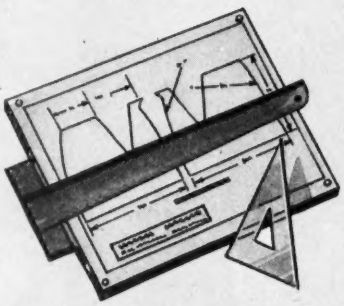
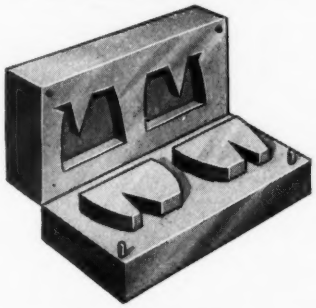
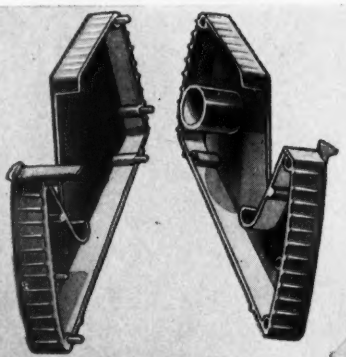


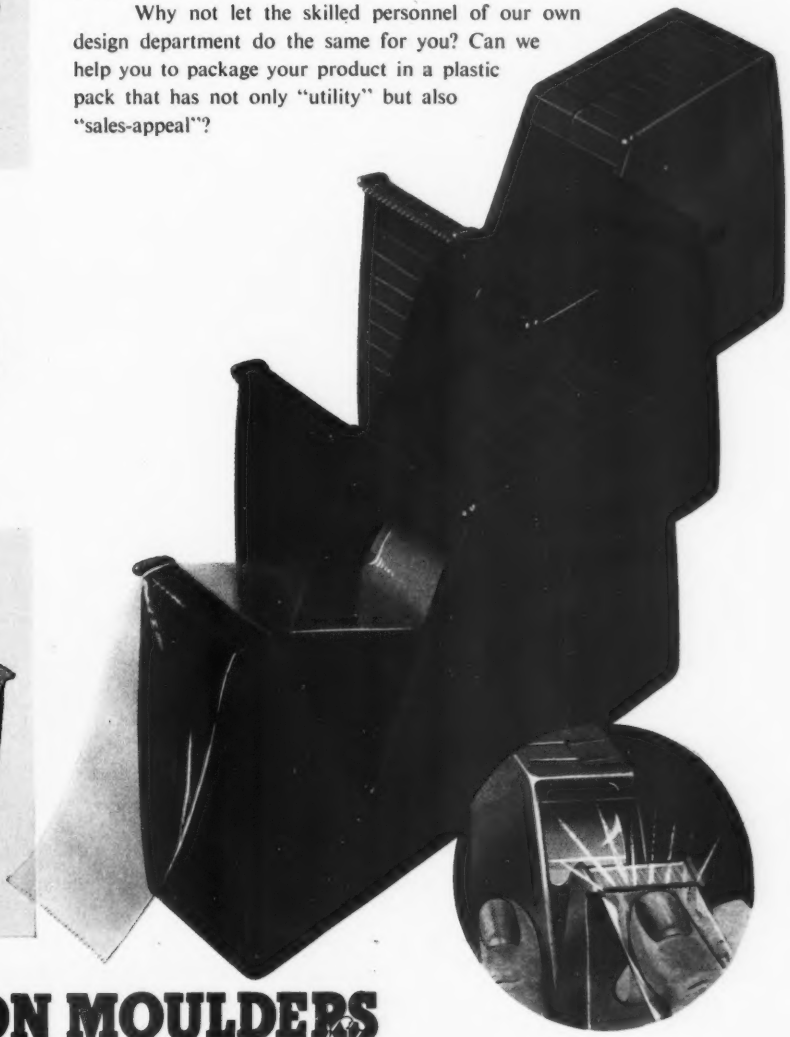
Our designers got busy



The moulds were manufactured



And here it is—
a thoroughly efficient article



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EDITOR: M. D. CURWEN, B.Sc., A.R.I.C.
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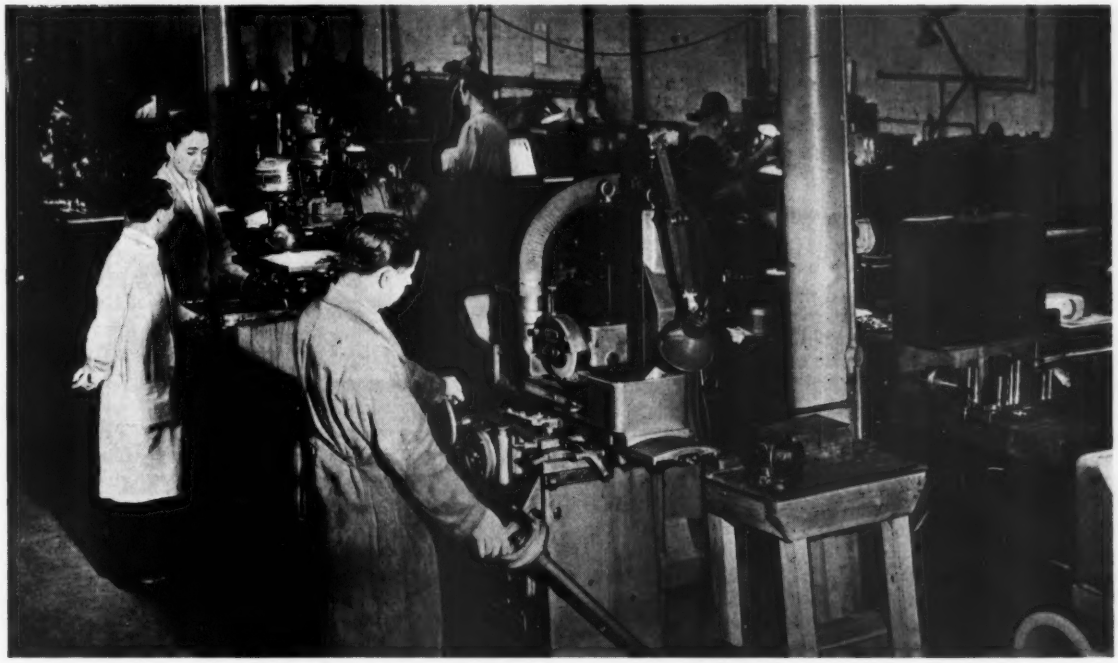

Toolroom at the Salford, Lancashire, works, of Universal Metal Products, Ltd.

NPI8

when it's something NEW in radio... National Plastics make the mouldings

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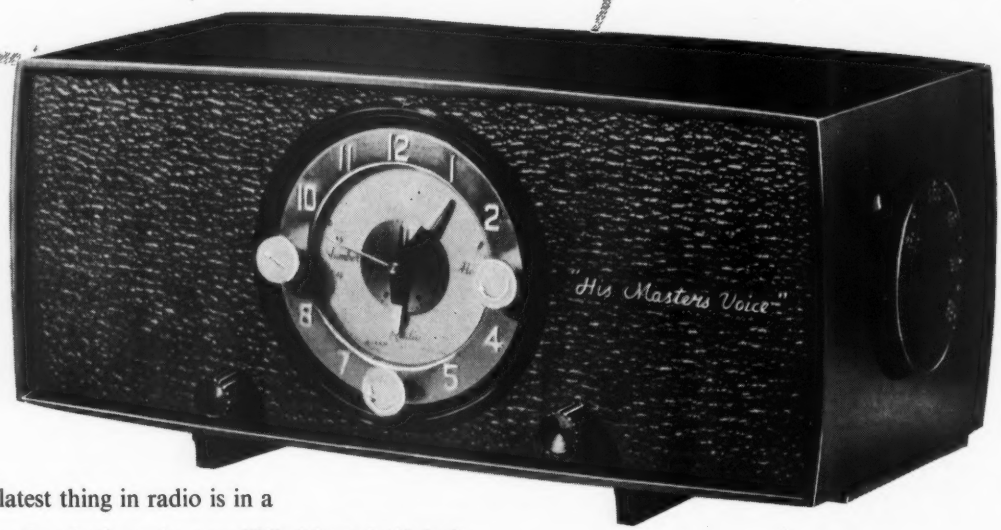

Naturally, the latest thing in radio is in a plastics cabinet. One look at the new "His Master's Voice" clock controlled receiver tells you why. Its colourful, contemporary look is just the thing for this intriguing example of modern radio engineering. It's natural, too, that the cases should come from our Walthamstow factory, where plastics mouldings have been produced in very large quantities for some seventeen years. No mean record, this, for a young industry.

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Plastics

VOL. XX. No. 214 MAY, 1955

EDITORIALS

Education Fund

OF all the activities in our industry there is none needing more urgent support at the present time than the Plastics Industry Education Fund. It was established in 1951 and has a yearly income of about £5,000. Let us be quite clear that this sum is not only woefully inadequate for the calls made on the Fund but, moreover, has remained static since its inception; we may also be very frank and declare that for an industry that has made such great strides in recent years, and which depends so much on a continued infusion of new blood in the form of advanced education in applied chemistry, physics and engineering, this condition is disappointing.

It is not surprising, therefore, to read in the 1955 Progress Report of the Fund, not only the setting forth in detail of what has been paid out to date in the form of grants, bursaries and scholarships to students, gifts of plant and instruments to technical colleges and the publication of monographs, but also the inevitable corollary—an urgent appeal for additional contributions. We for our part echo this appeal, for few can be so blind to the fact that we must build for the future.

If we may give our own opinion on the attitude of many to the structure of the Fund it is that the individual in the industry is under the impression that subscriptions are a matter for companies only, and, to be more specific, a matter for the 300 members of the British Plastics Federation. This we are sure is not so, but at least there seems to have been no clear appeal to all companies in the industry whatever their size and status and no specific appeal to individuals in those companies who might approve of the valuable work being carried out. Surely it would be advisable to widen the whole basis of support by approaching the 2,135 members of the Plastics Institute who, if they could afford it, would be glad to feel they are taking part in a worthwhile project. Subscriptions could be as low as £1 a year and even a few hundred such subscribers would give a splendid fillip to the morale of the Fund and guidance to companies who have so far heard little or nothing of the scheme. Concurrently, appeals should go out to every known working company in the country—there must be 500 to 1,000 of them—who must realize that the future of the industry, indeed of their own progress, lies in helping our youth to learn, to use and then to impart to others the sciences and technologies upon which we all depend.

Federation Luncheon

THE British Plastics Federation celebrates this year its 21st anniversary, so that it was especially pleasing that the chairman, Mr. A. E. Skan, and nearly 400 members and their friends were honoured by the presence of H.R.H. the Duke of Edinburgh as chief guest at the Federation's annual luncheon.

The chairman's review of events appositely went back to the beginnings of the organization at Ludgate Hill when plastics were few in number and limited much more than now in application. The great changes were to come later, especially during the war years, when our own lack of raw materials, natural and otherwise, and the difficulties of obtaining supplies from overseas to meet our urgent needs made it clear that plastics properly developed might solve our future problems.

What progress has been made, said Mr. Skan, is known now to the whole of the scientific and technical world and to the public, for plastics are employed in almost every industry; they expanded in more modern days to use below ground as conveyor belting in mines, on the high seas in ships as bearings and fittings and as dinghies and motor boats, in the field of decoration and in the home and even in the world of atomic energy and rocket propulsion.

The results may be seen in the trade returns for, with an increase in production of plastic raw materials valued at £56,000,000, we are exporting more than £20,000,000 worth compared with £13,500,000 in 1952. To this may be added the large quantities of finished goods which are so difficult of evaluation since the great proportion of them are components of electrical equipment, motorcars, refrigerators and so on.

We are to be congratulated that these results have been achieved by reason of improved methods of production and that we have kept our prices stable and in some cases even reduced them despite increased wages and higher costs.

The chairman concluded with the hope that His Royal Highness, who is so deeply interested in all scientific and technical advances, would be able to attend the Plastics Exhibition in June. The audience cheered their approval.

Day at Birmingham

THE Midland Section of the Plastics Institute has its own tradition as regards annual luncheons, in that the function bears little relation to formality and none at all in the choice of guest speakers. We remember in retrospect hearing with delight many of the secrets of a member of the Magic Circle who nearly told us how to saw a lady in half, and on another occasion to a member of the staff of *Punch* with even fewer affiliations to the plastics industry than the magician.

Last month we were again a grateful guest of the Section at the Queen's Hotel, in Birmingham, listening to Mr. H. N. Davies, the chairman, impart the results of his years of market research in Central Africa, where a wife may be purchased for six cycle reflectors and a chieftainship for a radio set.

Mr. Davies' main object was to introduce the chief guest and speaker, Professor Thomas Bodkin, head of the Barber Institute of Fine Arts at Birmingham University, formerly director of the National Gallery of Ireland and better known to most as a member of the television archælogical panel, "Animal, Vegetable or Mineral?"

We had expected a talk on architecture, but instead he told us about the friend of his youth, Sir Hugh Lane, the great Irish collector, who 40 years ago to the month died in the torpedoed Lusitania, and of the 39 wonderful paintings he left to England. It is not generally known that Sir Hugh Lane made a codicil to his will which would have given the paintings to Ireland. Unfortunately it was not legalized before his death and they remain here. Professor Bodkin pleaded that just as we returned the famous Kittyhawk (which the Wright brothers left to Great Britain), to the Smithsonian Institute in the U.S.A., so should we make a similar gesture to Ireland and return the paintings or make some arrangement whereby they could be seen in both countries.

Professor Bodkin's voice could charm the bird off the tree. Give him the pictures, Barney!

Journals of the Industry

WE have now received information that two new journals have appeared in the U.S.A., one, *Western Plastics*, which indicates a need for "local" journals in very large industrial countries and *Plastics Technology*, "a magazine of applied engineering."

Plastics Technology attracts our attention, more especially because we have just received a copy of the first number. Our first reaction is that we hope the editor will expand the subtitle to read: "a magazine of applied engineering, chemistry and physics." There are a number of excellent articles on "plastic tooling," "cam action for injection moulds" and so on, but there are also others of wider technology; e.g., the Kreidl process of printing on polythene, a description of the new polymer laboratories of the Pittsburgh Plate Co., etc.

There is, however, one article in this journal with which we scarcely know how to deal. It has the attractive and intriguing title, "New Fields to Conquer—the Future Outlook," written by Dr. Johan Bjorksten who has published work on high polymer chemistry and is president of Bjorksten Research Laboratories and of two other companies.

The first part of his article shows a considerable knowledge of plastics technology, e.g. the need for more rapid production and the trends towards this end, the need for examining and correlating all types of reinforcements, the need for further work on polymerization involving the use of radiation techniques and eliminating normally-used catalysts, and so on.

The remainder of the author's paper, that part which deals with applications of plastics, contains however certain statements that gave us the impression of having been written by somebody else or by the author in an unsuccessful attempt at technical humour or very doubtful scientific fiction. We may explain what we mean by the following abstracts. For example he looks forward to the production of "low cost resins of low hydrogen permeability (!) for use in water-handling and irrigation. The use of this exciting resin is elaborated thus. "In transporting water (over long distances and to high altitudes), why should we have to move the oxygen. . . ? Why not move just the hydrogen (to save weight and energy) . . . to a mountain top and regenerate the water there . . . to permit distribution of water . . . and make possible a hydro-electric energy gain." The author sees disadvantages in this, but "under certain conditions the advantages may outweigh the disadvantages," which no doubt is a very carefully thought out statement.

His last example concerns the future of foamed plastic (impregnated with hydrogen or helium) in agriculture ". . . the thought would be alluring to send a garden skyward, have it float as a cloud above the level of insects and pests and finally return to the ground by gravity when the crops have reached a certain weight."

It is possible that this is merely a sample of heavy humour. We believe it to be a complete farrago of technical and economic nonsense.

MOULDING POWDER AND SHOT

Had a really good day out at the Brantham factory of B.X. Plastics, Ltd., in company with Miss Joan Cutting, of Andrew Reid's organization, and who therefore represented the British Plastics Federation, a Mr. P. Morgan, editor of a journal, technical I believe, and my old friend, philosopher and guide of B.X., Mr. MacDonald Watson. Apart from what I went to see there—the horizontal Plax lay-flat polythene tube-making machine, the production of hard p.v.c. girders for supporting p.v.c. chemical tanks, the manufacture of golden hair for R.A.F. officers and dolls (no, not R.A.F. dolls, fathead!), the extrusion of 16-in. diameter polythene and acetate tubing—I also got my first peep at their enormous p.v.c. sheet-producing Farrel-Birmingham machine in action. With ancillary equipment, I estimated with my so-knowledgeable eye the cost to be something of the order of a quarter of a million pounds. With experience one is able to do this fairly accurately. Four rollers at £4,000, two Bunsen burners at each end of each roller to keep temperature constant £1 15s. 3d., large copper kettle for hot water supply £2 6s., cardboard squares under the supports to keep level 1s. 6d. . . . well, that's a sample of my method. We left tremendously impressed, with lots of secrets regarding production. Next morning I read that B.X. shares, which had dropped 1½d. prior to our visit, had gone up 3d.

Cause and Effect?

As my uncle Lancelot (Slush) Dogsboddy used to say "You'll never get anything you want without push" and his dear friend Harry the Barman always admitted that "Slush was the boy to push it around." I never did quite understand what "it" was, for my uncle was a black-and-white artist pure and simple and the way he used to amuse us on Sunday nights by imitating Mr. Bradbury's and Mr. Beale's signatures was a fair scream. As you know he passed on, as we say in Fleet Street, some years ago and I suppose he's now imitating St. Peter's signature on all-night passes just for fun. What I really wanted to say was that the Editor has written on the previous page as nice a bit of fancy work as ever you saw about the Plastics Industry Education Fund, in his usual genteel style, with about as much push in it as a completely busted extrusion machine. The way to get company directors to subscribe is to tell them it's an insurance and to keep on telling them and they'll understand at once that they're getting value for money. They insure themselves and especially their ever-loving wives, their factories, stocks of powders, their moulds and machines and their homes and lovely television sets. Why, if every company in the plastics industry gave to the Fund each year one-fifth, or even one-tenth, of what they pay their newest office boy, they'd be taking out the finest insurance of all for themselves, their works, the country and posterity (although what posterity has done for us so far I haven't the foggiest idea). And Mr. P. C. Allen, the chairman of the Fund, would smile once again! Well, the 300 members of the British Plastics Federation started the ball rolling by donating £16 13s. 4d. each per annum to make up the first £5,000 a year income. What's that you say? Have I said something funny? My arithmetic's wrong? Oh, dear! Anyway, now it's up to the whole of the industry to do something about the Fund.

£5,000... £10,000... £15,000...

A long time ago, probably between the years 1927 and 1930, I was anxious to visit and "write up" a new factory, Solvent Products, Ltd., that had been erected at Dagenham to make industrial alcohol from molasses; the fermentation methods and the distillation plant showed a most advanced stage of technology. Generally such works were not easy of access but my approach to one of the young directors of the company, Mr. C. G. G. Hayman, resulted in his enthusiastic help and close interest in the construction of a technical story not commonly available in those days. I saw the same young director again last month as one of the principal guests at the Federation luncheon. He is now Sir Graham Hayman, is a director of the Distillers Co., Ltd., and president of the Federation of British Industries.

After Many Years

DOGSBODDY.

Production Story

Transfer moulding is often the only method of moulding a complex component. The following article, based on a visit to Universal Metal Products Ltd., reports the moulding technique employed with a Ferranti meter terminal block.

OVER 20 years ago a company was formed in the north of England to manufacture collapsible metal tubes. The screw caps, to be moulded, were to be contracted out to trade moulders in the plastics industry. Due to special production difficulties, deliveries could not be effected in the desired time, and within a month of its inception the company was committed to a moulding programme of its own. From that day to this, Universal Metal Products, Ltd., have been prominent in the plastics industry, despite the strong link with the tube field, and with expansions recently completed and now in hand have become one of the biggest moulders in Britain.

Approximately 1,200 employees man the Salford and Southport factories. At Salford is located the head office, embracing sales and accounts, tube making, compression moulding, a reinforced plastics section, chemical laboratory and tool room. The majority of moulding tools are made within the organization, and the laboratory is capable of extensive analytical and testing work both in resins and moulded products.

Injection Moulding

At Southport is the injection moulding factory, housed in new buildings and enjoying all the advantages of a modern layout. The company's press capacity is formidable, 75 compression presses from 10 to 350 tons and 33 injection moulding machines varying from 2 oz. to 48 oz. capacity. In the former field considerable use is now being made of Bipel equipment.

With such a varied programme of work, U.M.P. presents a fascinating field of study to the technologist, and demonstrates once again how a successful moulding business so often emerges from a moulding capacity initially designed for internal consumption only. U.M.P., now one of Britain's big trade moulders, shares this well defined evolutionary pattern with such giants as E. K. Cole and the Witton Moulded Insulation Works of the G.E.C.

Transfer Moulding

In this production story we are concerned with the moulding of a particularly intricate meter case terminal block, by the transfer technique.

Transfer moulding was developed from about 1937 onwards. G. K. Scribner described in some detail, in 1938, methods of gating such mouldings, and drawings were published in 1939, compiled by A. Amigo, showing a typical transfer moulding set-up. Essentially, the technique remains the same today, and consists of a heated chamber, above the mould cavity, into which moulding powder is charged and heated to flow point. By means of a piston action the free-flowing powder is transferred through the sprue into the mould cavities, the whole assembly being maintained under positive pressure. A natural advantage of the process is that delicate inserts can be moulded into place with far less danger of damage or misplacement than would be the case with a positive, semi-positive or flash-type mould. Additionally,

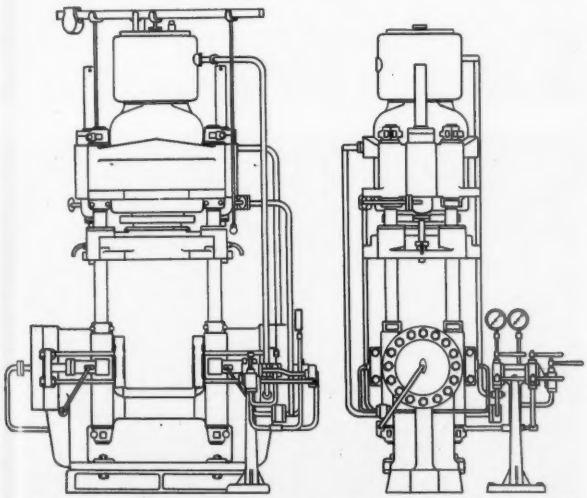


Fig. 1.—A typical Bradley and Turton Ltd. 150-ton transfer press.

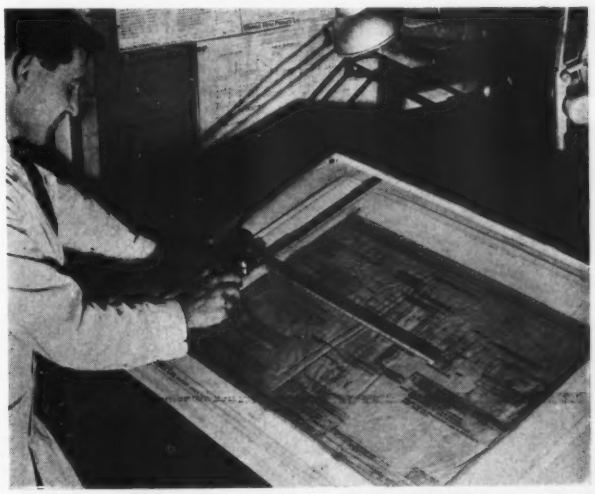
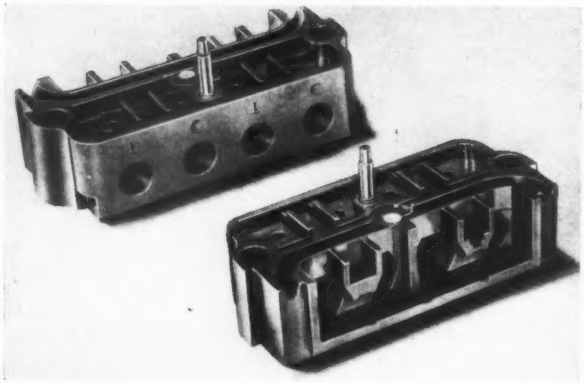
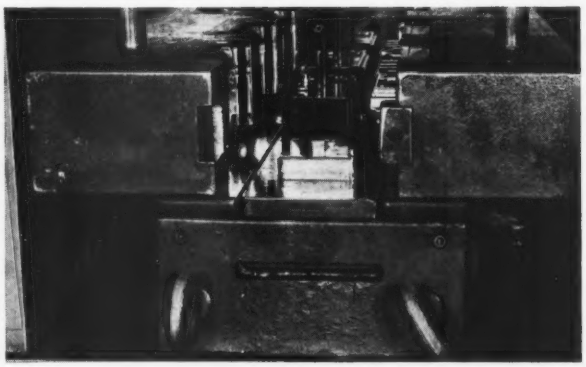


Fig. 2.—Mould design in the drawing office.



Column one photographs, from top to bottom:—Fig. 3. Moulded terminal block; Fig. 4. Splits open; Fig. 5. Mouldings in place; Fig. 6. Press assembly.

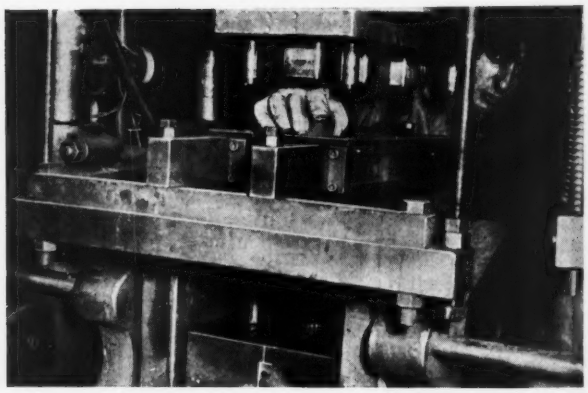


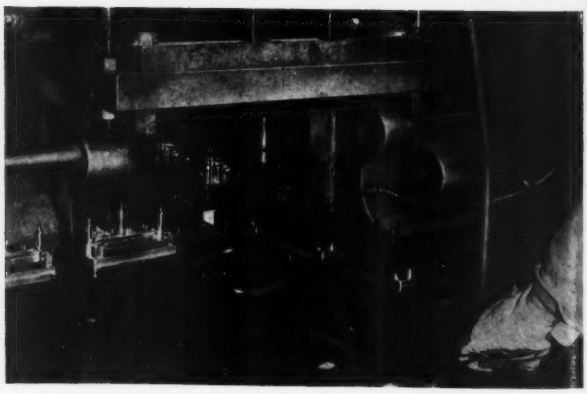
finishing costs are generally only two-thirds those of the conventional process, being limited in many cases to removal of the sprue. A greater uniformity of cure through a thick section is also an advantage of the process. A drawing of a typical Bradley and Turton transfer press is shown in Fig. 1.

For those who are not familiar with the transfer moulding process, a word on the presses used may be useful. The main point of difference between a conventional down-stroking hydraulic press and a transfer press is that the latter is equipped with side rams. As can be seen in Fig. 1, where a front and side elevation are shown of a 150-ton side ram press, the main pressure is applied to the plunger, which transfers the heated and flowing plastic from the pot into the mould cavities. The side rams constitute, in fact, the sides of the mould cavity in the case of the moulding discussed here, and fulfil also the purpose of supplying sufficient pressure to prevent the forcing open of the mould by the force exerted by the inward flowing plastic from the pot. In the case of the Bradley and Turton press shown, the side rams in each case are of 150-ton capacity. The diameter of the main ram is the same as each of the side rams, 14¼ in. The stroke of the main ram is, however, 18 in., whereas the side ram stroke is 4 in.

Transfer moulding was probably the only method of producing the terminal block which was submitted by Ferranti Ltd., to U.M.P., as a proposed moulding. Ferranti specialists had evolved a design which in itself was an interesting piece of work; meter units, supplied to countries all over the world, could, within certain limits, be standardized. The terminal block, however, was of necessity altered in many important respects from country to country, and the ideal objective was a tool which, by rapid modification, would produce the variety of blocks required at will.

Photographs below:—Fig. 7. Press operator inserts pellets into pots; Fig. 8. Mouldings are extracted from the press.





Tool Design

U.M.P. designers (Fig. 2) therefore went to work, bearing in mind that the tool would have to cater for varying cable entries, thicknesses of copper connector strips, together with undercuts and cores in both the horizontal and vertical planes, and numerous brass inserts both front and back. The initial design was to cater for the needs of six different countries.

Eventually, a workable design was evaluated to meet these highly complex requirements and was then costed. This was followed by the placing of a contract by Ferranti, operative today. It is interesting to note that the original tools have now undergone further modifications, with the result that the needs of 24 different combinations of design can be accommodated. It is doubtful whether there has ever been such a universal tool embodying so many different features, and it reflects very creditably on the toolmaking department of U.M.P.

Moulding Procedure

Fig. 3 shows the moulding itself from two angles. Undercuts and cores are clearly visible. The method by which it is produced is seen in Fig. 4. The bottom force (upper force not shown) is broken down into three unit parts; side rams, shown here open, provide the cores and undercuts on each side. When closed together the upper force is located on the four dowel pins shown. The base of the mouldings is formed by the hand-manipulated plate seen in the centre. Two plates are in use, each giving three mouldings, and while one is in the press the other is being stripped of mouldings and reloaded with insert pins. These plates, in fact, constitute the key to the successful moulding of the terminal block, since they have been so designed that inserts can be moved from point to point, the holes being filled with blind plugs when not in use. Fig. 5 shows the splits open, and the moulded components in place. It indicates clearly the construction of this portable assembly. Of considerable weight, it is loaded into the press by means of a steel carrier.

A general view of the press assembly is shown in Fig. 6, where the plungers on the upper force are seen. In Fig. 7 the operator is loading the heating chambers, or "pots," with preheated pellets. In Fig. 8 the operator is shown extracting one of the plates with the mouldings in place. Fig. 9 demonstrates the method by which the inserts are positioned before the tray is loaded into the press.

The press assembly is shown closed in Fig. 10. On the left is the pre-heating unit and on the right can be seen the cylinder of one of the side rams.

Finishing Operations

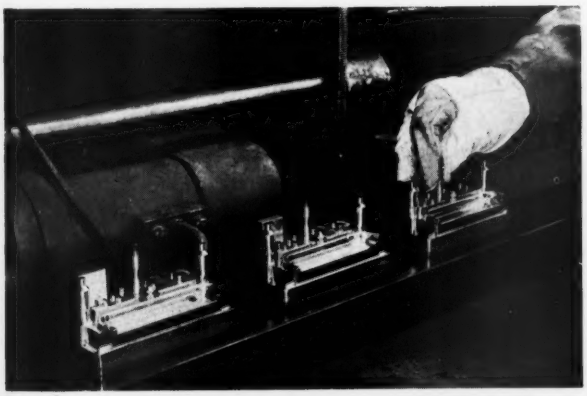
Output, using the one set of tools, is in the order of 4,000 per week. Finishing operations are, by the nature of the transfer process, commendably few, and consist of grinding to remove base of sprue, a limited amount of hand filing, and a final buffing operation. This is followed by inspection, prior to dispatch. Wherever possible finishing operations are jigged to speed production. An example of this is shown in Fig. 11 where the operator is drilling the sprue flush with block.

Mould design, mould making, moulding, finishing and testing; these are the prime functions of the trade moulder in the plastics industry and certainly could not be better evidenced than by this difficult moulding. It is certainly typical of Universal Metal Products.

Conclusions

Although concentrating largely on the manufacture of industrial components for the engineering, automobile, surgical equipment, radio, electrical and kindred industries, the company undertake limited manufacture of products for the specialized fancy goods and toy trades, also packaging and domestic product fields, where the company's trade name Decora has become well known. As a result, great experience has been built up which today is proving of special value. The lessons that have been learned are profiting the newer branches of the company's activities, injection moulding and reinforced plastics, and when the extensions, now in hand, have been completed, the Salford plant will constitute probably the most modern in construction and layout in Britain.

Photographs below:— Fig. 9. Press operator placing inserts on one tray, while other is in press. Fig. 10. Press assembly closed, pre-heating unit shown on the left.



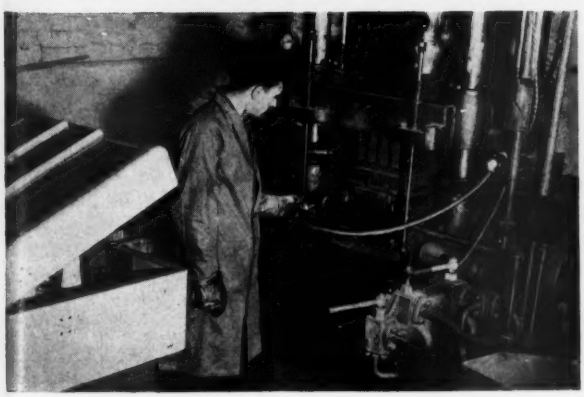


Fig. 11. Finishing operations are jigged to speed production. Here the operator is shown drilling the sprue flush.

The Future of Vacuum Forming

Current trends in machinery and materials point to a considerable expansion in the vacuum-forming industry in the near future. The following article reviews the progress that has been made and draws attention to some of the important developments currently in hand.

AT a recent meeting of the London Section of the Plastics Institute a distinguished member of the audience, having listened to two speakers discussing the vacuum-forming technique, posed a pertinent question: what is new about vacuum forming?

The answer is, of course, that vacuum forming is not new, having in various forms been a standard process for many years in the cellulose field. What is new is the adoption, by a diverse group of industries, of the process, yielding in essence a greatly enlarged range of applications. This in turn has stimulated research into materials especially suitable for the process, and the design and construction of machines capable of fulfilling the requirements of the many new fabricators. During the past three years we have in fact witnessed the transformation of a relatively little-used but well-known technique into a well-established industrial process, of sufficient importance to attract both machinery manufacturers and raw material suppliers.

The purpose of this article is not to explain in detail the vacuum-forming technique, since this has been done on several occasions already*; it is to relate the process to other existing and established processes, in an attempt to evaluate the future progress of the former. That this is even remotely possible is due to the freedom with which both manufacturers of machines and materials have publicized progress to date.

Development of Vacuum Forming

For all practical purposes, the significant development of vacuum forming has taken place in Europe in some two years. In the United States the process finally evolved as one of major importance in 1954, notably at the Cleveland International Plastics Exposition in the summer of that year. A leader of the Swedish plastics industry, present at the Exposition, said that beyond doubt vacuum forming was the most important single development.

Progress has been extremely swift. In December, 1953, the Swiss Hydro-Chemie company demonstrated the Formvac machine in London. In June, 1954, both the Edwards and the Pulsometer models were in production, and were followed shortly by the Yadran and Latymer machines. It is now possible to purchase a machine having a platen area of 675 sq. in., and a depth of draw of 12 in., for under £400. The smallest production version injection moulding machine (1 oz. capacity) costs more than twice this sum.

Materials too have made good progress. To the readily available cellulose acetate sheets of various thicknesses have been added p.v.c., polystyrene, and styrene copolymer of high strength values. Close collaboration between machine and material manufacturer has established much useful data on cycle times, effect of heat on plasticized sheet and the like.

However, the availability of machines and materials is of little use unless taken advantage of by the fabricators. The most telling information here is that there are estimated to be over 200 machines in use today in Britain; one-third the number of injection moulding machines.

We may now consider the foregoing information rather more closely as a guide to future developments.

From the standpoint of capital outlay, the vacuum-forming machine is probably the lowest-priced productive unit available today. Its true role as a producing unit has however been obscured to a large extent by the constant illustration of the process by large units, such as display cards. In fact, multi-impression moulds are being used with greater frequency, which brings comparison with injection moulding closer than ever. An illustration on this page shows a 20-cavity tool, each cavity turned and all retained in the wooden chase. The tool is used for forming powder puff packs, and operates on a 20-second cycle using 5 thou. acetate sheet. Lids are similarly formed.

Economics of the Process

What are the economics of a process such as this with a multi-impression tool? First of all, the raw materials are more expensive than moulding powders. This is however offset to a certain extent by the use of a much lower weight of material per unit. Wastage may at first sight be high, since even with objects having a square plan, a certain percentage of sheet is lost. To the vacuum former this material is completely wasted in that it cannot be reground and used again as can sprues and runners in injection moulding. The reduction of this wastage to an economic level is, however, really a matter of efficient mould design, and this touches upon a field which is relatively unexplored.

Just as machine cost is low, so also are mould costs by comparison with injection moulds. This feature has in fact misled many people into believing that no special consideration be given to mould design. Those who have taken the

20-impression tool by Latymer Engineering.

* Production by Vacuum Forming, by P. A. Sauter, *Plastics*, March, 1954, pp. 99-101. Vacuum Forming Developments in Britain, *Plastics*, August, 1954, pp. 253, 254. Pulsometer Vacuum Forming Machine for Thermoplastic Sheets, *Plastics*, August, 1954, pp. 274, 275.

problem seriously realize that in the design of the mould lies the true key to success with the vacuum forming technique. With injection moulding, limitations are relatively small; if more pressure is needed, a larger press can be employed. With vacuum forming the maximum pressure is a little short of atmospheric. The fabricator is therefore limited in the pressure he can use, and limitations are also in force on platen area. The major contribution to the improvement of productive capacity must lie in the tools.

British Manufacturers of Vacuum Forming Machines

Manufacturer	Maximum Moulding Area (in.)	Maximum Depth of Draw (in.)
W. Edwards and Co. (London), Ltd., Manor Royal, Crawley, Sussex.	22 × 25	7½
Latymer Engineering Co., Ltd., 27a Charles Street, London, S.W.13.	24 × 26	12
Pulsometer Engineering Co., Ltd., Nine Elms Iron Works, Oxford Road, Reading, Berks.	24 × 24 33 × 33 36 × 66	6 14 18
Yadran, Ltd., 137 Blenheim Crescent, London, W.11.	30 × 34	18

It may well be that the example of one machine maker who also offers a tool making service will also be followed by other manufacturers. Whether the established tool makers will enter the field on a large scale remains to be seen; certainly there is no theoretical reason why vacuum forming should not grow very considerably, in which case the toolmaking aspect would well repay close study.

For the moment, wood and light alloys provide the basic toolmaking materials. Plaster of Paris serves very well for sampling but lacks the strength called for in continuous use over wide temperature ranges.

Applications

To date, the most impressive advances made by vacuum forming have been in display advertising and packaging. The rapid expansion of vacuum forming during the past two years has largely taken place in companies outside the plastics industry, companies concerned in advertising novelties, signs and plaques, and packaging specialists. It is obvious that with improved printing techniques, metallized plastic sheet, and other advantages, vacuum formed plastics have a strong advantage over coated papers, papier-mache, and the like.

It would be wrong, however, to assume that the foregoing sets the limit for the process. Although there are many features of injection moulding that vacuum forming cannot reproduce, there none the less remain many applications open for exploitation. These will grow as the approach to the process becomes more catholic. As already noted, there is a trend away from the original idea that from one large sheet of thermoplastic material should be formed one large article. The former approach, widely practised, inhibited, and could continue to inhibit, the true development of vacuum forming. The forming of small parts, coupled with finishing techniques such as welding (H/F), cementing, stamping and cutting, permit ample freedom of manoeuvre to this new branch of our industry, without competition with injection moulding techniques.

Summary

Although the purpose of this article has been to forecast, some mention of current developments not already enumerated above may assist the reader in assessing the future of this process.

Currently popular and widely discussed is " drape " forming, the purpose of which is to reduce the thinning of the sheet excessively. Draping and the proper use of masks, both advocated by the Swiss specialist P. A. Sauter, have brought about many improvements; indeed, large mouldings having uniform or controlled wall thickness now offer considerable competition to injection moulding.

Machine design has reached the stage where temperature control of the sheet is simple, where depth of draw is of feasible proportions, and where automatic units are available. The last mentioned, at the moment of the single platen variety, cycles without assistance, from the clamping-into place of the sheet.

No doubt the forthcoming British Plastics Exhibition will highlight further developments. Meanwhile, there is sufficient evidence to show that in vacuum forming we have a new process at our disposal, one which in a remarkably short space of time has been widely adopted.

One of the new American vacuum forming machines built by the Auto-Vac Company, Inc., 2120 Post Road, Fairfield, Connecticut. Five standard machine sizes are available, the biggest having a platen area of 48 in. by 72 in.

Report on the German Plastics Industry

By Dr. WERNER KNEIP

As related in our April issue, we visited Dusseldorf on March 23, to attend the Press Conference to discuss the proposed German plastics exhibition to be held in that town from October 8-16, 1955. We have pleasure in publishing Dr. Kneip's talk herewith, given at a luncheon during the visit to Dusseldorf.

ALTHOUGH plastics already have today a wide range of applications, they are still only in the middle of their state of development, and new inventions are continuously extending their possible uses. The road to victory, which was started by the plastics after the invention of celluloid during the '70s of the past century, finds its expression in the following figures:

Whereas in 1900 about 20,000 tons of plastics were produced in the world, 2.1 million tons were produced in 1953, and the figure for the world-wide production during 1954 will probably have been around 2.5 million tons. What these production figures mean can be seen from a comparison with the figures for raw materials which have long been established and which have a world-wide economic importance. So, for example, the world production of copper is approximately 2.7 million tons, the zinc output amounts to about 2.1 million tons, the lead mined is about 1.7 million tons and the world-wide production of aluminium is about 2.8 million tons. When looked at from the point of view of volume, the production of the German plastics industry had already exceeded in 1953 the production of non-ferrous metals by about 50%. A fact worthy of special note is that, apart from Germany, the rise in the production of plastics has remained almost unaffected by crises, wars and post-war conditions. The United States, with their rich resources in natural raw materials, have now increased their production of the plastics from about 60,000 tons in the year of 1938 to about 1,300,000 tons in 1954; American production has been more than doubled during the period from 1947 to 1954 alone, so that this increase expresses not only the normal rate of growth, but also the shifting of emphasis from the natural materials to the plastics.

Until the 1930s, Germany was leading the world in the production and processing of plastics. This position was lost to the United States through the second World War and its consequences. In spite of its low number of consumers, Germany was still, up to the end of the war, the largest producer of plastics, along with the United States, with a production of 250,000 tons in 1944, because the plastics had to be used in Germany in place of numerous other materials which were not available. This development was broken off with the end of the war, and the task then was to start almost from the very beginning. In 1947 there were only 23,000 tons of plastics produced in the Federal Republic, which corresponded to approximately 30% of the pre-war production. During the same year, however, the world-wide production amounted to 870,000 tons. Therefore the production in Western Germany during that year did not even amount to 3% of the world production, whereas the United States reached 70% and Great Britain 13% of the world-wide production during 1947. However, developments went ahead with giant steps during the period which followed and in 1953 Germany, with a production of 240,000 tons, had again regained the second position in the list of countries producing plastics.

TABLE I—World-wide production of plastics

	In 1,000 tons				
	1947	1950	1951	1952	1953
W. Germany	23	98	168	190	240 = 11%
Gt. Britain ..	108	135	160	150	185 = 9%
France ..	24	27	40	35	46
Italy	9	15	26	29	44
U.S.A. ..	611	1,034	1,160	1,103	1,318 = 63%
Japan		18	42	50	53
Other Countries	—	173	204	243	214
World-wide	775	1,500	1,800	1,800	2,100 = 100%

In 1954 the production of plastics in Germany had reached a height of 325,000 tons. This represented an increase of 35% over the previous year, whereas the rate of growth of the chemical industry in Western Germany during the same period amounted to only 13% and the rate of growth of industry as a whole in Western Germany during that period only amounted to approximately 11%. In contrast with the previous years, the rate of the production increase had risen again. Of the overall production of 325,000 tons of plastics, 148,000 tons consisted of polymers, 130,000 tons of condensation products and 47,000 tons of cellulose derivatives. A comparison of these figures with those of 1936 shows that the proportion of cellulose derivatives, which at that time shared in the overall production with 30,000 tons, had sunken, whereas the polymerization products, which at that time only had a share of 2,000 tons, now represent the most important group of plastics.

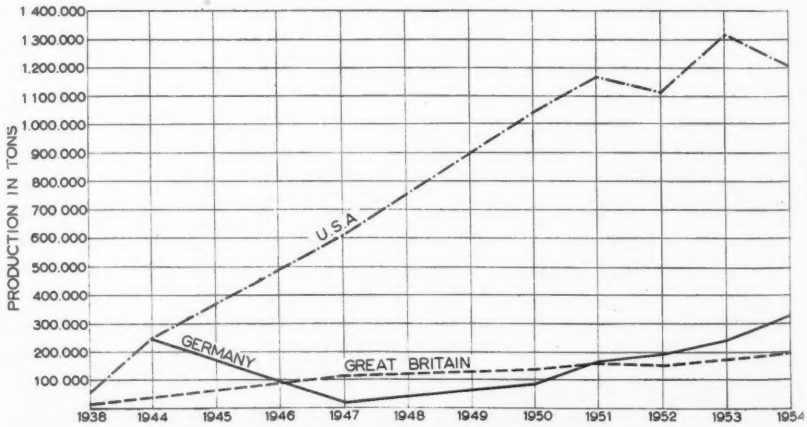
TABLE II

	In tons		
	1936	1953	1954
Cellulose derivatives ..	30,000	39,000	47,000
Condensation products ..	44,000	97,000	130,000
Polymers	2,000	104,000	148,000
	76,000	240,000	325,000

According to these figures, the increase of production in 1954 over 1953 amounted to 20.5% in the case of the cellulose derivatives, 34.0% in the case of the condensation products and 42.3% in the case of the polymers, and from all indications more than half of the overall production of plastics will, in the near future, consist of the plastics class of polymerization products.

The demand for almost all groups of plastics remained at a steady high level during the past year, and some products could not be supplied from the German production. New production capacities for polyvinyl chloride began to function during the course of the year. Others are being built at the present time. The production of packaging foils on a cellulose and polymer basis was increased considerably in the development of the perfect packaging techniques. Among the new plastics, the foamed plastics have found much favour among the consumers and the general public, so that here, too, the demand is going ahead of the extension of the production. In the field of the polyesters reinforced with glass fibres, the development work has been continued.

The turnover value of the plastic production in Western Germany has increased from DM720 millions in 1953 to somewhat over one thousand million DM in 1954. As a result, the industry producing the plastics rose in 1954 to second place



Production of plastics, in tons, of U.S.A., Germany and Great Britain.

From left to right. A. Reid, publicity officer, British Plastics Federation, Dr. G. Aston, "Industrial Chemist," W. Kennett, "The Times," M. D. Curwen, Editor, "Plastics."

within the chemical industry of Western Germany. Its share in the overall turnover of the chemical industry amounted to 8.5%, whereas the production of tar dyes (one of the oldest branches in the chemical industry of Germany) only amounted to DM600 millions, or 4.9% of the turnover in chemicals in the Federal Republic of Germany. The development of the ratio between the production of plastics and tar dyes showed a similar movement all over the world. The sales value of the plastics produced all over the world reached, in 1954, more than double the value of the production of tar dyes in the world which, with a production of 310,000 tons, had a value of approximately three thousand million DM.

The plastics still do not play the important part in world exports of chemicals as the other products of the chemical industry, as, for example, the tar dyes or medicines. From the total plastics production in the world, only about 10% is exported, and the proportion of the exports in the production figures of the individual countries varies considerably; it amounts to approximately 6% in the United States, approximately 31% in Great Britain, and in Western Germany, where the exports have a value of DM176 millions, almost 17% of the total turnover in plastics is exported.

Future Developments

As already mentioned, the plastics are being used in increasing measure as new types of materials. The developments shown here are as follows: Whereas during their initial phase of application the plastics were mainly used for articles of daily use, their use is now shifting more and more towards the technical side. This applies both to the shaped parts made of plastics as well as to the semi-finished products made of plastics, which are being used to an ever-increasing extent by the engineers to replace other materials. In addition, the plastics are finding more and more use as raw materials for further processing within the framework of other industries, where they are used in place of natural raw materials. There are also other branches of industry, as, for example, mechanical engineering, electrical engineering, as well as precision mechanics and optical industries, which are making their appearance to an increasing extent as the consumers of plastics. In addition to the typical plastics processing plants, there are also such branches of industry turning towards the plastics as have previously looked upon the plastics only as being raw materials for cheap consumer goods or articles of daily use. Famous concerns in the iron and steel industry last year bought participations in plastics processing plants or set up their own processing plants for plastics. The main products planned in this connection are plastics tubes. The light metals and glass industries are also looking into the possibility of making the articles they produce out of plastics. The realization of these plans would make the plastics into the basic materials used by the engineers in their work.

Special emphasis is to be given in conclusion to the fact that German science, which in previous years has enriched the plastics industry with a series of economically very successful products, has come forth with a new and considerable success in 1954. In the Max Planck Institute for the Chemistry of Coal at Muelheim (Ruhr), a process has been developed which makes it possible to produce polyethylene, one of the most promising of the plastics, without the use of pressure, whereas in the past pressures of over 1,000 atmospheres have had to be used.

Third British Plastics Exhibition and Convention

THE Third British Plastics Exhibition and Convention opens at Olympia, London, on June 1. Organized by the proprietors of *British Plastics*, in conjunction with the British Plastics Federation, the exhibition has become recognised as being representative of the British plastics industry, and all available information at the moment indicates that this year's event will break all previous records.

A special number of *Plastics* will appear on the opening day of the exhibition, June 1, and will preview the exhibitors' stands; exhibitors will be segregated under three main headings, raw material manufacturers, machinery manufacturers and moulders and fabricators. Included in this preview will be essential tabular information enabling the visitor to make speedy contact with exhibitors likely to be of interest to him. Summaries of the papers to be given at the Convention will also be published.

In another section of the June special number will be found a comprehensive review of the British Industries Fair in so far as it affects the plastics industry. Coverage will be given to both the London and Birmingham sites.

By way of introducing this special issue of *Plastics*, we publish herewith the titles and authors of papers to be read at the Convention:

Convention Programme

June 2, 10.30 a.m. Polymer structure and properties (1):

The synthesis of new types of addition polymers, by H. W. Melville.

June 2, 2.30 p.m. Polymer structure and properties (2):

Some properties of irradiated polymers, by A. Charlesby.

The molecular weight of polythene—its measurement and significance, by S. W. Hawkins.

June 3, 10.30 a.m. Expanded plastics:

The chemistry of modern blowing agents, by R. A. Reed.

The technology and uses of polyurethane foams, by L. N. Phillips.

June 3, 2.30 p.m. Thermoplastics:

Dispersion of polytetrafluorethylene, by H. M. Whitcut.

New nylon polymers and compositions, by R. H. Birtles.

June 6, 10.30 a.m. Extrusion:

Fundamental problems of single-screw thermoplastic extruders, by E. Gaspar.

June 6, 2.30 p.m. Work study:

Work study in the plastics industry, by J. Grange Moore.

Productivity and methods in moulding, by A. L. Sparshott.

June 7, 10.30 a.m. Injection moulding (1):

The effect of injection moulding variables on the quality of mouldings, by K. C. Bryant and G. Hulse.

June 7, 2.30 p.m. Injection moulding (2):

Recent advances in injection moulding techniques and in the evaluation of moulding materials, by G. Campbell.

Runners, gates and vents for thermoplastic moulds, by A. G. Elwell.

June 8, 10.30 a.m. Patents:

British and International patent practice as it relates to the plastics industry, by A Chartered Patent Agent.

June 8, 2.30 p.m. Foundry resins:

Recent developments in the use of plastics in the foundry, by P. G. Pentz.

June 9, 10.30 a.m. Glass reinforced plastics (1):

Consistency in glass reinforced moulding, by J. Rees.

Glass reinforced plastics in automobile construction: their advantages and limitations, by H. Silman.

June 9, 2.30 p.m. Glass reinforced plastics (2):

Chemical engineering possibilities of glass reinforced plastics with special reference to polyester resins, by V. Evans and J. R. Stevenson.

The testing and development of high-quality glass fibre polyester laminates, by P. H. H. Bishop and E. Haythornthwaite.

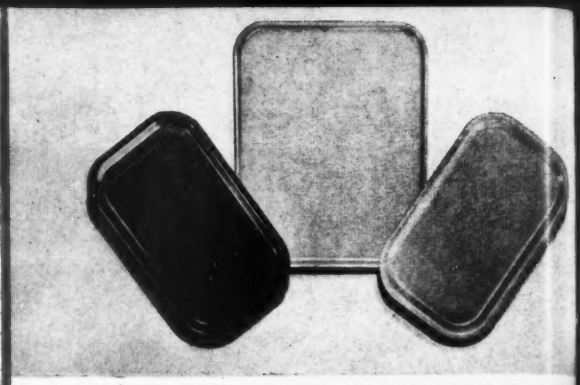
Epoxide resin/glass laminates, by W. J. Marmion.

PLASTICS
IN THE SERVICE OF MAN

A pictorial review of high-quality units moulded or otherwise fabricated in Great Britain . . .

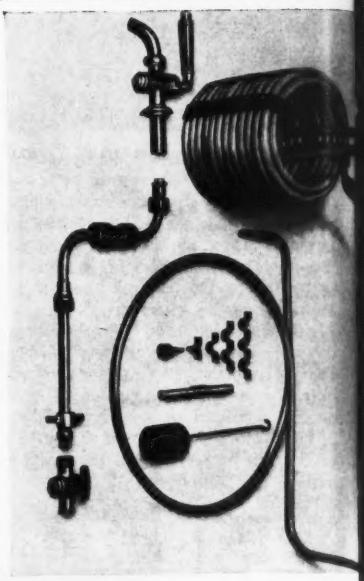
57. The Brewing and Distilling Industries - II

A list of trade-marks and companies mentioned in this review, with full names and addresses, appears on page 154



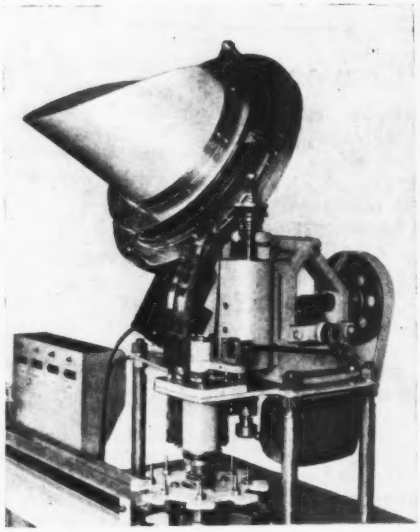
(Above) Laminated waiter trays manufactured by Helenaware Ltd.

(Right) Rigid p.v.c. fittings supplied for the brewing industry, by Horwitch Smith and Co., Ltd.

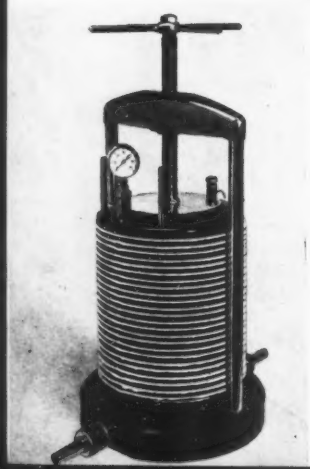


(Above) The saloon bar of the "Kenilworth Castle," Shepherd's Bush, where extensive use has been made of Formica laminate.

(Right) B.X. rigid p.v.c. hopper used on the Gravfil Machines Ltd., bottle capping machine.



(Left) Injection moulded by Halex for William Sanderson Ltd., these red acetate seals have the appearance of sealing wax.

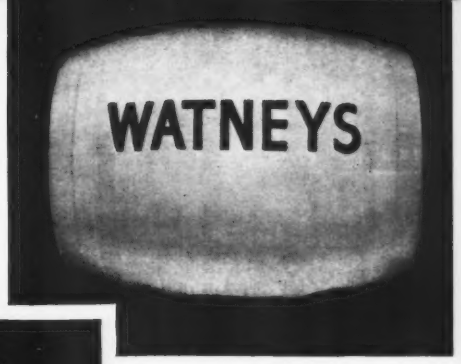


(Left) Filter press for clarifying and sterilizing wines manufactured by Coin Insulation Ltd. The plates frame, base and head are made from asbestos/resin laminate.

(Right) Surfacing of bar tops in Warerite laminate at "The General Smuts," Shepherd's Bush.

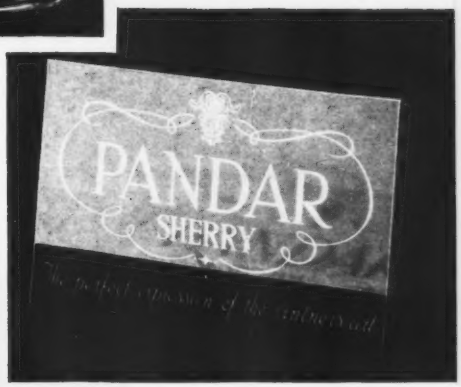
(Right) Nylon hop filter manufactured by British Rawhide Belting Co., Ltd., for Watney Combe Reid and Co., Ltd. (*Plastics*, 1955/Feb./52).

(Right) Advertising sign made from Perspex by Pearce Signs Ltd. (*Plastics*, 1954/Dec./392).



(Above) Warerite bar surfacing at the "Cross Keys," Queen Street, Stirling.

(Left) A sandwich case fabricated in Perspex by Triplex Safety Glass Co., Ltd.



(Above) Display cards manufactured from Cinemoid by British Celanese Ltd. (*Plastics*, 1953/Oct./342.)

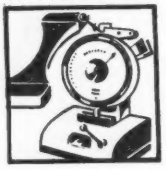
(Right) Perspex direction sign at the Plaza Cinema, Birmingham.

(Above) Beer hose, extruded from p.v.c., in the cellars of B.X. Plastics Ltd., canteen.

(Right) Formica bar facing in the "Duke of Wellington," Bromley-by-Bow.

World's Industry Employs Plastics

MATERIALS and TESTING



Adhesive - bonded aircraft structures.—The National Bureau of Standards tested recently such structures to obtain a better understanding of bonding. The bonded joints are difficult to inspect and imperfection, which can become dangerous, can only be detected by destructive tests. This demands either completely reliable fabrication procedure or satisfactory non-destructive inspection.
(*Technical News Bulletin,* 1955/Jan./11.)

Rigid vinyl moulding material.—Japanese workers have investigated the various factors which influence flow and thermal stability of rigid vinyl and its mechanical properties, as well as its moulding properties.
(Reports of electrical communication lab. Nippon Telegraph and Telephone Public Corp., 1954/Nov./12.)

Silicones.—An up-to-date survey on silicone-base polymers used from aircraft gaskets to auto-polishes, i.e., including silicone fluids and compounds, silicone resins and silicone rubbers, has been given by K. Rose.
(*Materials and Methods,* 1955/Feb./107.)

Impregnated wood.—A new material of 1/10-in. or 1/16-in. solid mahogany veneers impregnated with phenolic resins and bonded together is said to have improved dimensional stability and resistance to swelling and shrinkage.
(*Materials and Methods,* 1955/Feb./136.)

Fluorocarbon polymer.—Material now available in granular, powder and dispersion form. Three grades with varying molecular weights are produced. They can be formed by conventional thermoplastic moulding and extruding processes.
(*Materials and Methods,* 1955/Feb./136.)

Use of polyester plastics.—Production methods and correct uses were discussed by D. Wilson.
(*Tool Engineer,* 1955/Feb. 1/202.)

Friction of nylon bearings.—R. C. Bowes reports on investigations of the American Navy on the friction and lubrication of gears and bearings of nylon.
(*Ind. Eng. Chemistry,* 1954/Nov./2416.)

Viscosity of thermosetting resins at hardening temperatures is determined by a new method of D. I. Marshall. Rapid viscosity changes which accompany thermal hardening can be followed.
(*A.S.T.M. Bulletin,* 1955/Feb./40.)

Ultrasonic testing.—G. B. Baumeister provides data correlating the various parameters for the production testing of bonded materials with ultrasonics, such as extent of unbonded area. He describes also typical industrial applications for the detection of lack of bond.
(*A.S.T.M. Bulletin,* 1955/Feb./50.)

Mechanical properties of polyester glass laminates.—The effects of time, temperature and environment on tensile, compressive and flexural properties of six representative types have been determined. Data may be useful in designing structures such as pipes subjected to continuous stress in the presence of water.
(*A.S.T.M. Bulletin,* 1955/Feb./54.)

Polyester fibre.—D. N. Marvin reported on the various industrial uses of Terylene polyester fibre. By heat-setting techniques fabrics and cords can be effectively stabilized.
(*Inst. Prod. Engs. Journal,* 1955/April/231.)

Plastics as technical materials.—A survey of the increasing use industry is making of plastics has been given by K. Krekeler and H. Penkert.
(*Industrie-Anzeiger,* 1955/Feb. 25/57.)

Injection moulding.—G. B. Thayer describes the precision control of injection moulding pressure. The quality of plastics products will be improved by more dependable weight feeders, uniform moulding cycles and automatic compensation.
(*Mechanical Enginering,* 1955/Feb./151.)

INDUSTRIAL APPLICATIONS

Reinforced plastics turbine blades.—Still in development is the use of fibrous glass reinforced blades in the third stage of a compressor rotor. Main idea was finding a fast and cheap method of making prototype blades.
(*Automotive Industries,* 1955/Feb. 1/75.)

Cast-in drill bushes.—A new feature for drill bushes in trim-and-drill fixtures is to cast them in position with an epoxy resin. This is said to give a big time saving for the aircraft industry.
(*Modern Machine Shop,* 1955/March/128.)

Gearwheels of polyamides.—The particular advantages of polyamide (nylon) for gearwheels are discussed by H. Peckhaus.
(*Industrie-Anzeiger,* 1955/Feb. 25/59.)

Polyamides as materials for precision mechanics.—A general survey article has been presented by H. Beck and H. R. Jacobi at a recent conference. In order to avoid failures it is necessary to know the proper ties of this material in advance.
(*Feinwerktechnik,* 1955/Jan./10.)

Plastics bearings.—Tests on plastics bearings for rolling mills have been made at the laboratory of G. Vogelpohl, Goettingen; a detailed report has been made.
(Forschungsberichte des Wirtschafts-und Verkehrsministeriums Nordrhein-Westfalen No. 89, Köln und Opladen, Westdeutscher Verlag, 1954.)

Multi-ply plastics belting.—J. Lewis describes p.v.c. belts specially introduced to avoid fire hazards in conveyor belts underground.
(*Mining Journal,* 1955/Feb. 18/177.)

Hot-spray vinyl paint builds up a firm thickness in two coats equivalent to five coats of cold-spray vinyl material. Tygon ATD combines vinyl and other plastic resins to form a viscous material with a high content of solids.
(*Design News,* 1955/March 15/89.)

Plastics cam.—Selective programming of several electric circuits in an appliance timer is controlled by a rotating cam, to which the entire control programme is moulded by circular strips.
(*Machine Design,* 1955/Febr./160.)

MISCELLANEOUS USES

Japan's Plastics Industry survey of the production of raw material for the plastics industry. Data are given on plastics processing, in particular injection moulding. Interesting details on plastics applications.
(*Kunststoffe,* 1955/Feb./55.)

International standardization.—Report of the meeting of international committee ISO HC 61 at Brighton at which 61 delegates from Belgium, France, Germany, Great Britain, India, Italy, Netherlands, Sweden, Switzerland and U.S.A. participated.
(*Kunststoffe,* 1955/Feb./58.)

Specimen preparation for mounting metallographic specimens. One uses either Bakelite or Transoptic (Lucite-Plexiglas) which, owing to their different nature, have different moulding properties.
(*AB. Metal Digest,* 1955/Jan./5.)

Plastics bodies.—The French view is that plastics car bodies have remarkable possibilities for the making of prototypes and even for small production runs, but their value for the series production is still doubtful.
(*S.I.A. Journal,* 1955/Jan./43.)

Plastics engineering conference.—A short report on important papers was given at a recent meeting of the Society of Plastics Engineers which had a record attendance.
(*Automotive Industries,* 1955/Feb. 15/92.)

All-plastics truck cab.—Great emphasis is laid in U.S.A. on the use of reinforced plastics for truck cabs, bodies and miscellaneous cab and body parts made of polyester glass combine.
(*Automotive Industries,* 1955/Feb. 1/65.)

Peelable plastics packaging.—Techniques for protecting workpieces, tools, etc., by cellulose acetate. Butyrate and dioctyl phthalate plastics combined with some resins, plus a rust-inhibiting oil, are discussed.
(*American Machinist,* 1955/Feb. 14/152.)

German technical collaboration.—A. H. Kotthaus gives a survey on the establishment of technical committees in Germany to further research, general knowledge and standardization in the plastics field.
(*Industrie-Kurier "Tecknick and Forschung,"* 1955/March 2/79.)

Lifeboat of laminated glass fibre.—A ship's lifeboat is said to be resistant to corrosion and attack by boring insects.
(*Shipbuilding Shipping Record,* 1954/21/668.)

Plastics floats for seaplanes.—Permanent plastics wing-tip floats are provided on the new model of the Martin Sea Master. They will supply wing-tip buoyancy when the big swept-wing aircraft is at rest in the water.
(*Automotive Industries,* 1955/March 1/51.)

Modern "Merchant Adventurers"

The Golden Jubilee of O. and M. Kleemann Ltd., was celebrated by a luncheon, on March 30, at the Savoy Hotel, London. Dr. J. C. Swallow, chairman of the plastics division of I.C.I. Ltd. proposed the health of the company. We have great pleasure in reproducing herewith Dr. Swallow's address.

WHEN I was asked by Mr. Derrick Kleeman to propose the toast of his company on the occasion of their 50th Anniversary, it gave me a great deal of pleasure, not only because of their contributions to the plastics industry, but also because, when I arrived in Welwyn Garden City in 1942, I was privileged to get to know Mr. Max Kleeman and his family, and I was very soon conscious of the affection and respect he inspired in all around him, and of his zest and interest in life and in new things.

To aid me in proposing this toast, I was given an advance copy of this excellent book, which gives the detailed history of the company and, furthermore, deals with the personalities in it in a very frank manner.

Histories of Industrial Companies

A feature of the present time is the increasing interest in the history of industrial companies and their achievements, particularly in the chemical industry, and this is, perhaps, natural, for unless we see the activities of our predecessors in their proper historical perspective, we cannot hope to learn the lessons of the past and plan intelligently for the very different conditions of the future. Some of these histories that have been published are somewhat over-glamorized, and in certain cases produced possibly in order to impress the shareholders. But one is struck, in reading the better ones, by certain factors common to them all. They have in all cases been started by one or two people whose enthusiasm, single-mindedness and courage have carried them through what appeared to be insuperable difficulties at the time.

One also notices that all successful pioneers seem to have had a sense of the romance of their endeavour and, more importantly, they seem to have been primarily interested in their families and, secondly, with the human relations with their employees, and these considerations seem to have dominated their thinking, much more than immediate material success. If you look at the lives of the builders of the bigger industries, to take a few names at random, Carl Bosch of the I.G., Ludwig Mond, Alfred Nobel, and Irenee du Pont, you will find that they all have these characteristics, and in the case of O. and M. Kleemann, although not a very large company, from what I know of them they have them, too.

(Left to right) Mr. Jack Kleeman, Lord Nathan, Dr. J. C. Swallow and Mr. Derrick Kleeman at the Golden Jubilee luncheon at the Savoy Hotel.

Today we operate in a very different atmosphere from those pioneers of 50 years ago. In the first place, we have not only the complications arising from size and the necessity for increasing diversification, but the ever-growing complexity of life, both professionally and personally, with which we have to cope, whatever our positions and responsibilities. This is the age of functionalization of endeavour to a degree which in 1938 none of us present could have ever suspected. We are surrounded by experts and often in danger of surrendering initiative to them, and the difficulties of integration over so many fields of thought present entirely new problems, which at times appear impossible to solve. We even get to the point at times when it seems simpler to jump on an aeroplane and go 3,000 miles rather than write a letter. In fact, we get to a point where movement becomes a substitute for thought.

One may ask whether, under these circumstances, the pioneer or "Merchant Adventurer"—a term which has been so aptly applied to the founders of this company—has the same opportunity today to create new things. I believe this is still possible, but only if certain things are kept firmly in mind. If someone really believes in some worth-while technical or commercial objective, then he must remember that it is still people who do things, and not organizations. The organization merely provides the conditions under which the right people can operate. I well remember the remark of a prominent official of the I.G. in 1939, on being shown a piece of polythene, "that he really could not understand it because, after all, his Research Department had been organized to invent it."

Furthermore, it must not be forgotten that it is very difficult to push development in this modern world, because there will always be many people, highly skilled in their various technologies, who can produce almost irrefutable arguments that nothing one wishes to do can have the slightest hope of success. In that connection, I again remember one of the most distinguished chemical engineers in America saying to me before the war that the synthesis of polythene was extremely interesting, but was no more than an academic curiosity, since by inspection the heat of reaction could never be dissipated in any equipment which any engineer could devise.

However, any individual convinced that he has something that he wishes to add to the technical or commercial welfare of the community must be prepared to involve himself in the complex human relations with all the various people who today go to make up the success of any venture. He must, in fact, have the same characteristics as the pioneers of any age, and he must operate in a much more complex society, and today his reward will be the satisfaction of having made a contribution, and the large number of friends he makes in doing it, who add to the richness and satisfaction of his life. He must, however, like those before him, be willing to sacrifice much that today is considered so desirable and necessary, namely, security and his proper position in the hierarchical ladder.

Coming back now to our hosts, O. and M. Kleemann, and the plastics industry, what do we see? Here we have a

relatively small company who had the foresight, courage and imagination to sponsor a new branch of the plastics industry in this country in 1938 in the field of injection moulding of cellulose acetate and polystyrene. At that time I remember being told that polystyrene was brittle and crazed very easily, and did not have much of a future. I have known other plastics to suffer from these deficiencies, but it was clear to anybody interested in plastics that these disadvantages could, and would, be overcome. I doubt at the time whether Kleemann's ever made a market survey, and I doubt, in fact, whether, when they made the decision, they had anything more than intuition and a zest for doing new things, and a determination to take calculated risks. Their reward was the foundation of an industry which has flourished ever since and has now inevitably broadened into wider fields of manufacture. It has always seemed to me, since my association with the plastics industry, that success in the real sense of the word is largely a matter of timing, and that whereas you can afford to be one or two years late in sensing a new technical trend, you cannot afford to be five years late, and Kleemann's certainly appreciated at the right moment. Their company, therefore, has contributed to the increasing variety and widening pattern of the plastics industry in this country, and they can feel well satisfied that, through their endeavours, they have added to the wealth and pleasure of the country which their founders adopted.

Nevertheless, quite apart from the plastics industry, I would think that the success of Kleemann's—and it has been a successful enterprise—has been due as much to the fact that they kept throughout their history a nucleus of devoted staff, and perhaps that is their greatest strength, and without that fundamental contribution I doubt whether in the future in this country any industry, large or small, is likely to be really successful in the very long run.

The founders of this company have handed on the torch to their children, who have been inspired by their example.

Therefore, gentlemen, it gives me very great pleasure to propose the health and continued success of O. and M. Kleemann—truly "Merchant Adventurers," coupled with the name of their chairman, Mr. Derrick Kleeman.

The Plastics Industry Education Fund Appeal

ON April 20, an appeal was issued to companies comprising the plastics industry by the Plastics Industry Education Fund Trustees. At a reception given to the Press by Mr. P. C. Allen, at I.C.I. House, Millbank, London, S.W.1, on April 20, the objects of the Fund were re-stated; Mr. Allen hoped that with the co-operation of the technical press the work of the Fund would be made known to a wider group of people with subsequent benefit to the income of the Fund, which, at the moment is of the order of £5.000 a year. The Trustees have made available a progress report covering the period March, 1952, to March, 1955. In view of the importance of education to the plastics industry, extracts from this progress report are published below.

Objects of the Fund

The Plastics Industry Education Fund was established as the result of an appeal in 1951 to the plastics industry by the Trustees of the President's Fund, which was started in 1942, but had become dormant. When it was found that the appeal to form a new fund had met with a fair response a new Trust Deed was drawn up and signed on March 6, 1952, with the following Trustees representing subscribers:—Mr. P. C. Allen (Chairman), Mr. T. L. Birrell, Mr. J. L. Daniels, Mr. P. A. Delafield, Mr. C. S. Dingley, Mr. H. V. Potter, Mr. A. E. Skan. On July 2, 1953, Dr. V. E. Yarsley was appointed as an additional Trustee.

The objects set out in the Trust Deed are:—

1. To found scholarships and to give prizes for the promotion of education within the plastics industry in the British Empire and Commonwealth.

2. To assist needy students who are being educated in the science and technology of processes used in the plastics industry by making monetary grants to them.

3. To procure the publication of monographs and other educational information for students in the science and technology of the plastics industry.

4. To assist Colleges and Institutions for the promotion of education within the plastics industry.

The fund is administered by the Secretariat of the Plastics Institute as the agent and manager of the Trustees, acting through the secretary to the Trustees.

Income

All the remaining assets of the original President's Fund, amounting to £2,022, were transferred to the Fund in March, 1952. In addition the following amounts have been received:—

Donations,	1951-1955,	£3,624
Subscriptions	,,	£14,799
Interest	,,	£191

Expenditure

The income of the Fund has mainly been spent on the following:—(1) Training grants to students at Universities and Technical Colleges who are studying full-time for first-degrees or equivalent qualifications. (2) Bursaries for full-time students at the Borough Polytechnic, London, studying for the Diploma of the Plastics Institute. (3) Scholarships for full-time students at the College of Technology, Birmingham, studying for the Associateship of the Plastics Institute. (4) Monographs on plastics technology. (5) Grants for the purchase of capital equipment at Technical Colleges. (6) Contribution towards the cost of an exhibition of plastics at the Science Museum, South Kensington. (7) Books for the Plastics Institute libraries. (8) Administration, postage, stationery, audit and accountancy fees and legal charges.

The Future of the Fund

So far the Trustees have been able to budget for an income of about £5,000 a year, out of which the managerial costs have amounted to £1,300. These costs include a fee to the Plastics Institute for secretarial and clerical services and the legal and auditing fees. The Trustees are satisfied that the work which has to be done for the Fund could not be efficiently carried out for less than this amount, which would not increase significantly if the total income of the Fund was doubled or trebled. Thus £3,700 net per annum is left at the disposal of the Trustees. In the immediate past it has been decided that £1,000 should be used annually for training grants to needy students and £2,000 for bursaries at two Colleges, leaving £700 for libraries, etc.

The Trustees feel that perhaps their most useful work is being met by payments of training grants to needy but promising students and by the provision of bursaries and scholarships at the Technical Colleges, but, looking into the future, the Trustees consider that it would be much to the advantage of the industry if they had more funds at their disposal. If, for example, they could budget for an income of £10,000 a year rather than £5,000, their spendable income would be increased by the entire amount of the extra contributions. This would give the Trustees a much greater feeling of security and the chance to enlarge some of the schemes which they feel are already working well. With a net income, after expenses, of, say, £8,700 a year, they would be able to allow, say, £1,000 as before for Training Grants and perhaps as much as £6,000 a year for bursaries at Technical Colleges, leaving £1,700 for monographs, libraries and other expenses.

There are, of course, other ways of employing such an income, and the Trustees have seriously considered the provision, perhaps yearly or perhaps in alternate years, of a travelling scholarship, but they have felt that, with such a limited income as they have at present to administer, a travelling scholarship for one person cannot be justified. They have felt, too, that the larger University scholarships which were offered by the earlier President's Fund were making a contribution for the benefit of too few people to be justified while the present income prevails.

The Trustees feel that the industry should do its very best by making donations and contributions under covenant to provide rather more for the Fund than in the past, and they appeal to all firms and individuals in the industry to help them.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

"Plastic" or "Plastics"

[EDITOR'S NOTE: The following two letters are the personal views of two leading members of the plastics industry.]

SIR,—I agree with the opinion expressed on page 36 of the February issue of *Plastics* that the use of "plastics" instead of "plastic" as an adjective (for example, "plastics material") is discordant and unfortunate. It appears to me to stem from an inferiority complex regarding these materials. In the late 'twenties and early 'thirties much of this type of thinking went into agitation for an entirely new name; later, these same advocates were kept busy trying to keep high-pressure salesmen for other materials from riding along on the prestige and public acceptance of plastics as modern materials of construction.

I think that a suitable guideline for the use of "plastics" as an adjective is to substitute in the proposed phrase the word "metals," which covers another well recognized group of materials of construction. No one would be caught talking about a "metals doll" or a "metals product;" it would be a "metal doll" or a "metal product." However, "metals industry" is a commonly used term, just as is "plastics industry." Here we are undoubtedly guilty of using the plural noun as an adjective, which is an impropriety that occurs routinely.

G. M. KLINE,
Chief Division of Organic and Fibrous Materials.
U.S. Department of Commerce,
National Bureau of Standards,
Washington, 25, D.C.,
U.S.

SIR,—The note on p. 26 of the January issue of *Plastics* brings up again the vexed question of "plastic" versus "plastics."

Those of us who have been connected with the industry for a long time well remember the coming into use in the early 1930s of the word "plastic," which in those days was used either as a noun or an adjective. I think many of us were worried at the time because an existing word was clearly being used in new senses. However, most people accepted "plastic" whether they were technically concerned with the industry or whether they were simply consumers or users of the new materials. In time the word became so common that it is now virtually part of the language (see Concise Oxford Dictionary, Third Edition, p. 1493). In fact, it was used not only by English speaking people but in translated forms by the French, the Italians and the Russians. It was at least a euphonic word and everyone knew what was meant by it.

Then came the time, about five or six years ago, when someone who thought he had a logical mind decided that the word was ambiguous, standing as it did both for the plastic state and for a certain class of materials. It was obviously too late in the day to coin a fresh word, so what was done was to modify the existing word by the addition of an "s," whereby, as you point out on p. 36 of your February issue, "plastics" became used both as a noun and as an adjective. One could say, for instance, under the new system, that "p.v.c. is a plastics" or that "p.v.c. is a plastics material."

I find both these constructions repellent In the first place, to use a word like "plastics" both as noun and adjective is not English and secondly it is not euphonic. I have always set myself against the change and still insist on using the old term "plastic." Naturally, I do not dispute the functions of the British Standards Institution and the British Plastics Federation in acting as technical advisers to the industry, and if they had invented an entirely new and synthetic word, I should not have objected. I doubt, however, whether their functions extend to modifying the English language, by trying to insist upon the use of a dreadful hybrid like "plastics."

I would add that on several occasions I have submitted articles and papers to technical journals and have seen the word "plastic" altered to "plastics" by the editor; although I have drawn attention to this in the proofs and have asked that "plastic" should be used, my wishes have always been ignored. Surely authors have some rights in the drafting of their own contributions and should not be dictated to, however indirectly, by external technical organizations.

You will see from this letter that I am strongly opposed to the present ruling to use "plastics" instead of "plastic." In this, I believe I am at one with U.S.A. opinion. I discussed the point with some American scientists in New York in 1951, and I found that they also disliked the recommendation. I must, of course, admit that the people to whom I spoke, although they were connected closely with the plastics industry, may not have been completely representative of U.S.A. ideas.

In case misunderstanding may arise, I would point out that, in the preceding sentence, "plastics industry" is used in the same sense as one would use "metals industry" or "dyestuffs industry"; the word "plastics" is here employed as a plural noun.

N. J. L. MEGSON.

"Silvering" Plastic Sheet

SIR,—There is a new plastic material on the market which is silvered on both sides but very flexible and looks like a mirror. We should be extremely grateful if you could inform us who the manufacturers are as we wish to stock it as wholesalers.

CRAFTS AND TRADING, LTD.
William Street,
Bangor, Caernarvonshire.

Vacuum Metal Deposition

SIR,—We are interested in the vacuum depositions of metal on plastics, and shall be much obliged if you could give us technical information on this subject.

We are wondering whether the necessary plant is available from any manufacturer and if so we should be grateful for your help in passing their name on to us.

KESSLERS (LONDON), LTD.
201-203 Stoke Newington Church St.,
London, N.16.

Plastic Netting

SIR,—One of our customers recently informed us that whilst in Africa he purchased some plastic netting, green in colour, which he understood was manufactured by a firm, Messrs. Tygan, Ltd., of Manchester. Unfortunately we have been unable to trace such a firm, and we should be grateful if you could provide us with the full address of this company, or alternatively advise us of any other manufacturer who is producing plastic netting.

BAIRD AND TATLOCK (LONDON), LTD.
Freshwater Road,
Chadwell Heath,
Essex.

[EDITOR'S NOTE: "Tygan" is the trade name of the plastic netting made by Fothergill and Harvey (Sales), Ltd., Harvester House, 37 Peter Street, Manchester, 2.]

Nylon Mouthpieces for Pipes

SIR,—Will you be good enough to let us have the names and addresses of firms who manufacture nylon products; you may know some who actually produce mouthpieces for pipes.

KEYSER MANUFACTURING CO.
2 Norfolk Terrace,
Brighton,
Sussex.

Mechanical Applications of Polyester Resins

By J. R. STEVENSON *

The following article was originally read as a paper before a symposium on reinforced plastics at the Birmingham Central College of Technology on February 17th. The comments by the author are of particular interest at this juncture, incorporating as they do some interesting details of a recent American tour.

THERE are many ways of handling polyester resins and fibrous glass to give the desirable end product, but there are five main application methods:

(1) Hand lay-up.
(2) Preforming in conjunction with matched metal tooling.
(3) Laminating in low-pressure presses.
(4) Dough mixing and pressing.
(5) Pre-impregnation.

Since this paper is concerned with handling the polyester resin/fibrous glass combination by mechanical methods rather than by hand method, items 2, 3, 4 and 5 will be discussed with the emphasis on items 2 and 4. This is not to be taken as meaning that there is no importance attached to the techniques of lamination or pre-impregnation—in fact, quite the reverse view is held, but the length of this paper dictates that all items cannot receive equal treatment, so two have been selected for more detailed treatment.

Laminating

This method is useful in the manufacture of corrugated and flat sheets. For press work the fibrous material is laid on the lower tool, the liquid resin poured carefully on to the fibres, the press closed, and the resin is cured at temperatures in the range 105°-120° C. and at pressures as low as 50 lb. per sq. in.

It is of interest to note that one U.S. custom moulder is using this method to produce translucent and opaque sheeting, corrugated, but not in the sense of the usual "big six" asbestos sheeting. Because of the matched metal tools under pressure, the cross-section is extremely even and there are no air bubbles, but there is obviously a limitation to sheet size, and it is believed that the current maximum is 8 ft. by 4 ft. As mentioned, the corrugation is not of the usual undulating profile, but consists of ribs running the length of the sheeting on about 4-in. centres, the ribs themselves being about ½ in. wide and ¼ in. deep.

The largest single outlet for polyesters in the U.S., and this is also probably true in the U.K., is for fabrication of translucent corrugated sheeting of the "big six" type. By far the largest proportion of this is produced by the conventional hand lay-up technique, but it is interesting to mention that two firms in the U.S. are producing by continuous laminating machines. The stock produced from these machines is sold in roll form, naturally with the axis of the roll parallel to the corrugations.

Pre-impregnation

Perhaps at the outset it would be as well to define what is meant by this term. It means that the moulder purchases a resinated stock, that is the fibrous stock has been resin impregnated, and the user has only to tailor this material to his required form and mould it in matching tools.

A specially prepared pre-impregnation resin is made by the resin manufacturer and this is supplied to the impregnator either in the form of a free-running powder or dissolved in a suitable solvent. Suitable solutions include acetone, methyl ethyl ketone, and hydrocarbons of the benzene/toluene type. Solvents like acetone are preferable because of their low boiling point and freedom from after odour with removal of the solvent. It will be observed that all these solvents are extremely inflammable, which is a disadvantage. Solvents with similar characteristics to acetone but non-inflammable would be very useful for the process.

Impregnation is carried out in a conventional-type tower, but currently work has been concentrated on fibrous glass in the form of a woven textile. This material has been used because of its ability to support its own weight and that of the resin and solvents when it is in the wet state. This is a somewhat difficult problem with the conventional chopped strand mats, but no doubt this difficulty will be overcome in due course.

The control of the impregnation is somewhat tricky owing to the fact that the resin must be catalysed, and it is very important to see that during the removal of the solvent the resin cure is not advanced.

With the pre-impregnated stock a degree of tack is desirable, but it must not be so tacky to stick to itself during storage.

The advantages of using pre-impregnated stock include:

(a) It permits the moulder to proceed immediately with his moulding operation, eliminating handling of sticky, viscous resin, and also eliminating any toxic difficulties associated with handling of liquid-type resins.
(b) The storage problem is eased, since there is only one raw material to consider and no thought need be given to storage of liquid resins, catalysts, promoters, etc.
(c) Control of the moulding cycle should be easier if the impregnation has been uniformly carried out. Repeatability of the characteristics of the moulded part should also be facilitated.

The main disadvantage is on the score of cost. Other disadvantages are limited shelf life and possibility of adhesion to itself during storage. This last point can be taken care of by making use of polythene or other separator sheets, but this adds to the cost factor.

Preforming and Matched Metal Pressing

It is thought that the combination of preforming and compression moulding in low-pressure presses, using matched metal tools, is ideally suited for large-volume production of polyester resins/fibrous glass parts. Perhaps a word of caution would not be out of place here. In some quarters the view is held that all that has to be done is "to buy a bit of glass, a drop of resin, a few nails, some wooden battens, and an odd strip of sheet metal, and then moulded parts will flow just like shelling peas." This "rod-in-tub" thinking certainly cannot be applied to the aspect of polyester moulding under consideration. Somewhat expensive equipment is required in the form of preforming machines, dryers, tools, and presses. Even the most modest equipment will cost several thousands of pounds. Having spent the money, a good deal of know-how will have to be acquired before proficiency is attained.

Preforming Equipment

Preforming means making a fibrous glass chopped strand mat to the shape required. There are three main types of preforming machine:

(i) The so-called "plenum chamber" system.
(ii) The "open" system, where the fibres are placed at will by the operator.
(iii) Slurry system.

(i) is used in both the U.S. and the U.K.; (ii) and (iii) are used mainly in the U.S. as far as is known.

Plenum Chamber (i).—A machine is currently made in the U.K. and so it will only be briefly described.

In essentials the machine consists of a cutting head, the plenum chamber which houses a rotary table holding the preform screen, the main fan and the electrical controls. The fibrous glass required is in the form of roving, and it is of importance to see that the roving is of the right type—it is the hard type which is needed. The roving is fed into the cutting head, which cuts into standard lengths decided on by the operator; 2 in. is a reasonable fibre length. After cutting, some machines have a "combing arrangement" which, it is claimed, tends to separate the fibres and so give a better distribution on the preforming screen. The cut fibres, combed or otherwise, are then "snowed" or "showered" into the plenum chamber. The chamber is made of sheet metal, usually aluminium or stainless steel, which is as smooth as possible so as not to form a key to hold up any fibres. A baffle system in the plenum chamber helps to direct the fibres on to the table. The preforming screen, shaped as required, is fixed to a rotating table, usually inclined at a definite angle. The table revolves at 30-50 r.p.m. The screen is usually made from wire mesh, or thin perforated metal of about 16 gauge, with about ⅛-in. holes on about $\frac{5}{16}$-in. centres. These figures can be varied, but an open area of

* Development Engineer (Chemical), B.I.P. Chemicals Ltd.

about 40-45% should be aimed at. The fibres are sucked on to the screen under the action of a powerful fan. The roving cutting is continued until the preform thickness is built up to the required amount.

Circular or cylindrical preforms are easier to make than box-like sections. The fibrous glass build-up is usually light or thin on edges and corners. Baffling can help with this problem and internal baffles, both solid and perforated, in the screens should not be overlooked.

Screen size is important, and a good guide is that the finished moulded part should fit snugly on the screen itself. A preform which is too small will tend to tear during the moulding operation, and if too large will tend to wrinkle and overlap.

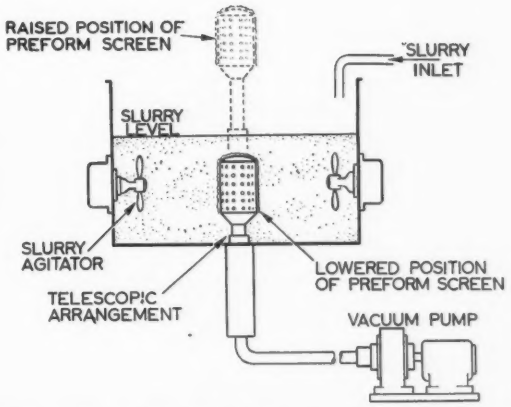
Having now made a preform to the size and shape required, it has to be bonded in some way, and this is usually done by some synthetic resin. Current practice is to use a polyester resin, if possible of similar constitution to the parent resin used in the main moulding operation. Generally, two methods are favoured: making use of a solid binder or a liquid binder. Solid polyester binders are available in the U.K. for this duty. The solid binder, in the form of a free-flowing powder, is distributed on the airstream during the course of the preforming process and is sucked on to the fibres under the action of the main fan. The binder is usually fed into the machine by some kind of electrical vibrating system. A disadvantage of the solid binder is the difficulty of control of its distribution and, secondly, a good deal of it can be lost to atmosphere, which adds to the expense of the operation. It should be pointed out that this could be taken care of by an adequate filtration system prior to venting to atmosphere. Liquid binders are probably more popular, especially in the form of an aqueous emulsion. This can be applied during the preforming operation by means of conventional spray guns, or can be applied when the preform is built up to the required thickness. The advantage of this method is that not so much of the binder is lost to atmosphere, and control of the distribution is better. It is possible to emulsify most liquid polyesters and these emulsions are usually infinitely compatible with water, which means that the aqueous spray can contain a very low solids content.

In connection with the use of solid binders, if a catalyst is required, it is perhaps pertinent to mention that a solid catalyst will have to be used.

The preforming screen and the preform are then transferred to a hot-air oven, where the resin binder is cured. This is normally done at a temperature of 176° to 204° C. for a few minutes.

The binder content can be varied at will and its function is simply to bind the fibres together in order to make the preform handleable. If the binder content is on the high side, the preform is somewhat stiff and is resistant to penetration by the parent polyester in the moulding operation. With a low content binder, the preform is soft and fluffy, but is less resistant to penetration by the parent resin.

The amount of binder to use depends on the shape and size of the finished part.



Diagrammatic arrangement of slurry preforming process. As will be seen, the preform screen can be raised after which the vacuum can be applied.

There are one or two variations of the machine just mentioned. These include:

(a) A large plenum chamber with several rotating stations.

(b) Two turntables on a sliding table, which is claimed to give double production.

(c) Ability to have hot air at will so that there is no need to remove the screen and preform and place in a separate oven. In other words, the drying is carried out in situ in the plenum chamber itself.

Another point of considerable interest is to have a variable cutting head. By this is meant that the length of glass fibre can be varied whilst the machine is in operation. The idea behind this is to face the preform with fibres of very small length, about $\frac{1}{8}$ in. to $\frac{1}{4}$ in. This is claimed to give a superior finish to the moulded part.

Open System (ii).—As far as is known this type of machine is not used in the U.K. but is popular in the U.S. This machine is used for the production of the well-known General Motors Corvette polyester resin/fibrous glass car. The machine differs from the one described under (i) in that it has no plenum chamber. As previously there is a cutting head, a revolving table holding the preform screen serviced by a powerful fan, but the fibres are directed via a venturi nozzle on an independent airstream from a blower. The fibres, chopped as previously, after passing through the venturi tube, are directed from about a 4-in. hose, held in one hand by the operator, and are played on to the revolving table, somewhat similarly to using an ordinary water hose. The usual binder is an emulsion of the parent polyester, and this is sprayed whilst the preform is being made and is directed by the operator's free hand.

An important consideration is to see that the fibres issue from the hose in a thin stream about the diameter of an ordinary pencil. This helps to locate the fibres, which is a matter of considerable importance when a small part is being formed. The advantage of this system is that the preform can be built up where desired as the fibre flow is strictly under the control of the operator. Further, the size of the part is not limited by the container or housing, since the spraying is carried out in the open. The disadvantages include waste of fibres that do not get sucked on to the former, the success of the job depends to a large extent on the skill of the operator, and the job also looks extremely untidy and very messy.

Slurry System (iii).—This method, as the name implies, makes use of a slurry, usually a water slurry, and the process is similar to that employed in the pulp-moulding industry.

Basically it admits the use of an additional fibrous material, usually cellulose, and is a method for mixing other reinforcing fillers with the glass. This is usually done at the expense of some loss of physical properties, but the cost factor is reduced.

The fibrous glass and cellulose, in the required proportion, are slurried in a tank of water. As in the pulp-moulding industry, the preform screen is in the tank, and is capable of being connected to a vacuum pump. After thorough mixing the slurry is sucked on to the screen and when the build-up is sufficient the screen is "telescoped" out of the tank and sucked as dry as possible. It is then dried off in a hot airstream as previously (see diagrammatic sketch).

Other advantages claimed for this method are that the preforms can be formed very quickly, are self-supporting and the fibres, both glass and cellulosic, can be dyed during the slurry process. This dyeing technique could help to lead to elimination of the fibrous appearance in the finished moulded part.

Tools

After drying, the preform is now ready for the moulding operation. This involves the use of tools and some pressing equipment.

Tools can be fabricated from Kirksite, aluminium, meehanite, or tool steel. Kirksite is a zinc-base alloy with somewhat low mechanical properties. It has a low melting point of about 378° C., which means that after use it can be easily remelted and cast. Both Kirksite and aluminium should be considered only for prototype or very low volume work. Meehanite is a close-grained cast iron and is used extensively for this type of work. The success with Meehanite generally depends on the casting process. If it is cast without porosity, which is a skilful operation, it gives a good tool when chromium plated. Tool steel is more expensive than Meehanite, but should certainly be considered in the event of a very long run being envisaged.

Current American practice with Meehanite

is to make use of flame-hardened cut-off edges. The cut-off is a very important part of the tool and has two functions. The first is to form a seal for the liquid resin and the second to cut off the flash and excess glass during the moulding action. It is extremely important to keep the cut-off clearance to a minimum.

Presses

Low-pressure compression presses are currently available in the U.K. Generally, these presses are large pieces of equipment having a big daylight and large platen area to cater for large moulds. The large daylight can be adequately reduced by a ram extension, which obviates the necessity of moving heavy tools in and out of the presses.

In connection with closing speeds, it is desirable to close as rapidly as possible up to the point of final closing, but the final speed itself is somewhat dependent on the job. A closing speed of 16-17 thou. in. per second is quite normal, but this can be dropped to 5 thou. in. per second in special instances. After moulding, sometimes the parting force needed is high, due to jamming or sticking, and presses are now available with a 75-ton pull-back. This is applied only over a very short stroke, the maximum distance being 1 in.

For the actual pressing, it is important that tool temperatures be very accurately controlled. A tool difference of 10° F. should not be tolerated. A difference of 1° to 2° F. is desirable and not impossible to obtain.

The chosen preform is placed in the press, the required quantity of catalysed resin, pigmented or otherwise, is carefully poured over the preform, the press closed, and the item moulded.

Important factors in the moulding operation are mould temperatures and choice of resin, particularly from the viewpoint of viscosity and high hot strength. The mould temperature is usually in the range 120°-125° C. and viscosity will obviously depend to a large extent on the shape of the moulded part.

The preform manufacture is of very great importance since a heterogeneous preform will lead to resin-rich areas which, in turn, can lead to cracking and areas of little or no strength.

There is some controversy as to whether the punch or die should be the bottom tool. Generally, other things being equal, it is preferable to have the punch on the bottom, since the preform will then drape reasonably easily on this tool. If the cavity is on the bottom and the article is of deep draw, it is a possibility that the preform will sag and be caught by the punch as it is being lowered. However, the job itself really dictates as to which tool should occupy the bottom position.

It ought to be mentioned that some moulded parts can be made without the aid of a preforming machine. The depth of draw is one of the main deciding factors here, but shallow trays of about 1-in. draw can be formed from flat chopped strand mat, and a preforming machine is not necessary. Mat tailoring may have to be considered.

Rubber Bag Technique

Before leaving this section a brief mention should be made of the rubber bag technique. It has previously been stated that large-volume production can well be handled by a combination of preforming and matched metal tooling. The rubber bag method is suitable for smaller production runs. For reasonable size parts production of hundreds per week can be within the scope of this method.

Dough Mixing and Moulding

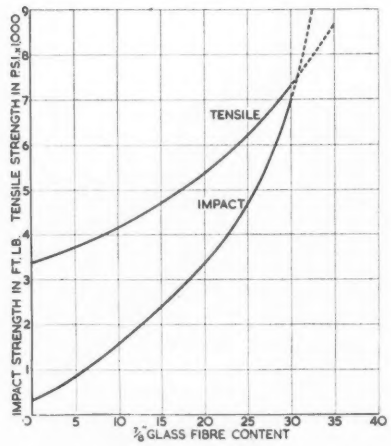
Dough-moulding compounds which go by the somewhat unusual name of "Gunks" in the U.S. look like a fibrous putty and consist of three main ingredients: polyester resin, reinforcing filler, and inert filler. The latter is in the nature of an extender or diluent, and thus tends to cheapen the mix. The strength of the moulded part depends to a large extent, but not entirely, on the reinforcing filler, which is usually fibrous glass. The resin plays an important part in the mix and has to have the right flow characteristics, since it is the only ingredient with any flow. It is important that the resin retains a good deal of residual viscosity at the tool temperature, otherwise with deep-draw parts and awkward bends, etc., resin separation can occur, forming resin-rich and resin-starved areas, giving rise to a moulding of poor quality.

Dough-moulding compounds are made in two main ways: a continuous method and a discontinuous method. The former is only meeting with moderate success and the greater proportion of dough-moulding compound used is still produced by the discontinuous or batch-mixing process so far as Great Britain is concerned.

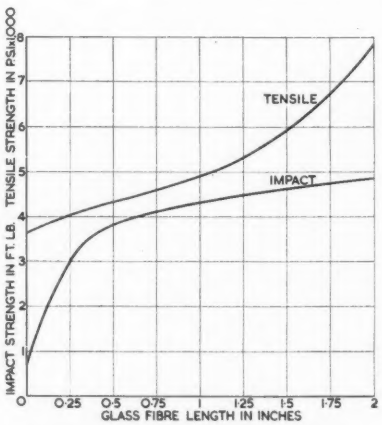
Continuous Method.—Very briefly, this machine consists of a device for impregnating fibrous glass in the form of rovings in a tank containing the resin mix. This mix is essentially the resin and inert fillers, together with the catalyst and pigments if required. The rovings slowly move through the tank picking up a certain resin-mix content and, after impregnation, the excess material is removed by a wiper.

Batch Process.—The object of this process is to mix the three ingredients together with the catalyst, in some form of mechanical mixer, in such a way that a reasonably homogeneous mix is obtained with the minimum amount of damage to the fibrous glass. This process is necessarily a compromise, since the longer the mixing time, the better the intimacy of mix, and usually the better the finish to the moulded part, but this is always accompanied by some fibre breakdown resulting in a moulded part of a lower order of strength. With shorter mixing times, the intimacy of mix is not so good, which means that the appearance of the moulded part is also not so good, but the strength characteristics are better than in the previous cases because of less damage to the fibrous structure. It will be gathered from this that a considerable amount of attention has to be paid to the design of the mixer. It will be remembered that in the opening remarks in this section the dough-moulding compound was described as a fibrous putty, and as such requires a lot of power for mixing. This means that the machine has to be of robust construction, and it has been found that the Werner Pfleiderer or Baker Perkins type mixer is reasonably satisfactory. The words reasonably satisfactory are used advisedly because it is thought there is scope for considerable improvement in the design of these machines for mixing the products under discussion. It is interesting to recall that with some initial experiments on dough

(*Continued on page* 162)



Graph I. Effect of glass content on impact and tensile strengths.


IMPACT STRENGTH IN FT. LB.
TENSILE STRENGTH IN PSI x1000
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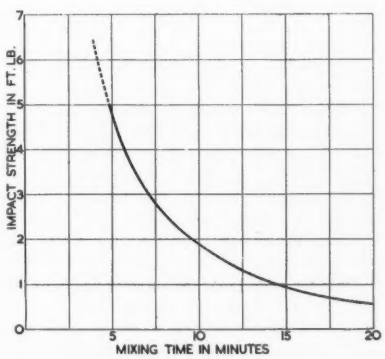
IMPACT
0 0·25 0·5 0·75 1 1·25 1·5 1·75 2
GLASS FIBRE LENGTH IN INCHES

Graph II. Effect of glass fibre length on impact and tensile strengths. Mix contains 20% glass fibre.



Graph III. Effect of mixing time on impact strength.

British Radio Components Exhibition

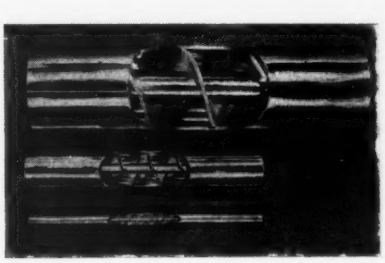
THE 1954 Radio Show brought to the fore the use of plastics materials in radio cabinets. New designs, contrasting grilles in thermoplastic materials and innumerable but less obvious other improvements showed the close link which has been forged between the Radio and T.V. industry and the plastics industry. The link is even stronger than at first it would appear, for a closer inspection of the internal workings of the receiver show a variety of plastics in a multitude of uses. At the British Radio Components Exhibition the full range of these varied uses can be seen. It is not only the domestic receiver that is served by this exhibition but also the rapidly advancing field of electronics which, it is forecast, will play such a large part in the future developments of industry.

Laminates

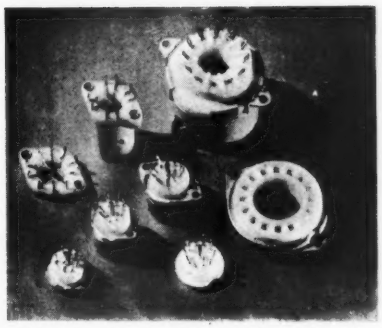
The importance of laminated plastics either paper or fabric based was evident by the number of manufacturers exhibiting, Bakelite, Ltd., Tufnol, Ltd., Thos. De La Rue and Co., Ltd., and H. Clarke and Co. (Manchester), Ltd., being a few of the well-known names in this field. Possibly the widest application for the sheet material is the latest printed circuit technique used for producing chassis base-plates. The laminate faced with copper foil has a special circuit drawing transferred to it by litho, silk screen or photo-engraving techniques. The surplus copper not protected by the inks used in the printing is then etched away leaving a permanent circuit. The savings in labour, space and material by using this method are obvious and need no emphasizing. The Telegraph Condenser Co., Ltd., have made a special study of this technique and some excellent examples of it were on show. Erie Resistor, Ltd., employ a different technique where no acid or etching process is necessary. The technique is basically a simple metal conductor embedded in a high-grade laminate. This is not by any means the only application for laminates and several firms, including Insulating Components and Materials, Ltd., and Langley (London), Ltd., showed coil formers, screens and insulators fabricated from laminated materials.

Cables, Wiring and Sleeves

Plastic-covered cable and wire has become an everyday material in our lives; so much so, that one sometimes wonders what was



Helical membrane co-axial cable made by Telegraph Construction and Maintenance Co. Ltd.



Components of p.t.f.e. made by British Mechanical Products Ltd.

used before for insulating wire. Polythene and p.v.c. are the most common materials used so far, but nylon and p.t.f.e. are now being used successfully for this application, the former by Duratube and Wire, Ltd., the latter by London Electric Wire Co., Ltd., and Transradio, Ltd. On the stands of British Insulated Callender's Cables, Ltd., and Telegraph Construction and Maintenance Co., Ltd., were samples of cellular polythene insulated cables. These cables, which are almost the same size and cost as the present light co-axial cables and television down leads, have the advantage that attenuation is increased, in some cases up to 40%. Attenuation is an essential factor for reception in fringe areas and will be in most areas when the new Band III service comes into operation. Telegraph Construction and Maintenance Co., Ltd., also showed the 50 ohm and 75 ohm helical membrane aluminium sheathed co-axial cable in which the membrane is of Telcothene.

Mouldings for Radio

Extensive compression and injection moulding services were being offered to customers by British Moulded Plastics, Ltd.; Bakelite, Ltd.; Thermo-Plastics, Ltd.; Creators, Ltd.; Hellermann, Ltd., and Cosmocord, Ltd., and a number of other firms. Products displayed included coil formers and bobbins in polystyrene, polythene and acrylic; pick-up arms, valve sockets, battery cases and knobs in phenolic, urea, and alkyd moulding compounds. Other mouldings included p.v.c., glass fibre laminates, nylon and cellulose acetate materials.

Polystyrene capacitor made by Suflex Ltd.

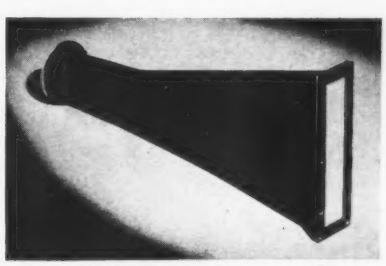
Tapes

A wide range of pressure sensitive electrical tapes using p.v.c., acetate, glass cloth, acetate cloth and acetate fibre as a backing material were on the stand of Minnesota Mining and Manufacturing Co., Ltd. In addition to the pressure sensitive tapes a new range using a thermosetting adhesive with paper, acetate, and glass cloth backings has been introduced. These tapes have been used to advantage in coil winding where components are given heat treatment and subsequent impregnation during manufacture. Varnished tapes using an oil modified alkyd varnish on a Terylene or nylon fabric were featured on the Micanite and Insulators Co., Ltd., stand. Both fabrics were also shown with polyurethane coatings. Diolpated p.v.c. for tapes, sleeves, and insulation which, it is claimed, has full flexibility over a range of temperatures of $-35°$ C., to 150° C., was shown on the stand of Permanoid, Ltd. Magnetic recording tapes of p.v.c. co-polymer were also featured on several stands.

Capacitors and other Components

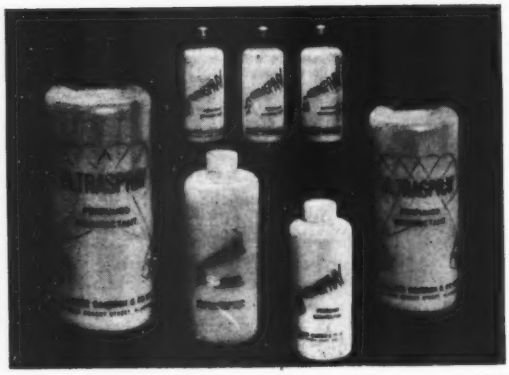
Various materials are being used in the manufacture of those small but vital components, the capacitors. Suflex, Ltd., showed some which appear to have been "potted" in polystyrene. Telegraph Condenser Co., Ltd., had metallized polystyrene capacitors displayed. On the Ministry of Supply stand a capacitor unit constructed from metallized p.t.f.e. film six microns thick and a complete capacitor using metallized polyethylene terephthalate film as a dielectric were shown. A special feature of the British Mechanical Products, Ltd., stand was the use of p.t.f.e. and polymonochlorotrifluoroethylene in electronic and allied components. Besides a wide range of components using these materials many new developments in the fabrication techniques were displayed.

Other uses for plastics were polythene insulators on television aerials, the use of epoxy and polyester resins for "potted" components and for coating wire, and Gresham Transformers, Ltd., displayed transformers encased and cast in synthetic resin offering a high degree of resistance to humidity and mechanical shock.



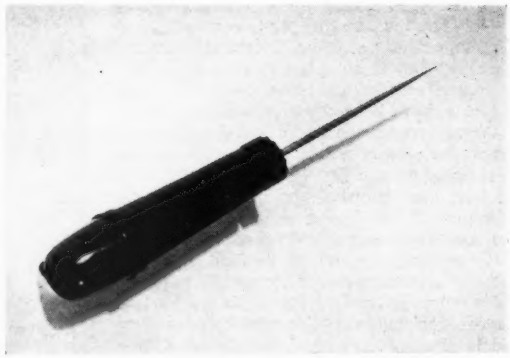
Radar wave guide with p.t.f.e. window for Marconi's Wireless Telegraph Co. Ltd., made by British Mechanical Products Ltd.

New Productions



(Left) Polythene bottles by E. Shipton and Co., Ltd.

(Right) Holder for diamond files made in Germany.



Polythene Bottles

Manufactured by E. Shipton and Co., Ltd., and distributed by Industrial Appliances, Ltd., 21 Grosvenor Street, London, W.1, the photograph above shows a new range of Ultraspray products ranging from 2 oz. to 1 gallon capacity. These are blow-moulded in polythene and are part of the Poly-Tainer series of products.

New Visual Charting System

A new visual charting system, the Prograph, has recently been introduced by Ernest M. Butler, Ltd., of Manchester. The basis of the chart is a grid moulded in Distrene polystyrene supplied by British Resin Products, Ltd. The grid is made up from small units to form 1,200 ¼-in. squares with dividing lines or bridges of $\frac{1}{16}$ in. thickness. The grid is ¼ in. in depth, so that into each recess a ¼-in. cube may be inserted of any desired colour as a symbol to represent a given fact. The six sides of a cube may have six different characters (like a dice) which makes for economy in signalling devices. When inserted into the polystyrene grid, the cubes are flush with the grid face and cannot, therefore, be accidentally knocked out. Control also renders the system tamperproof. When unlocked, unwanted signals may be pushed through the back or ejected by the insertion of another colour signal. A whole row of cubes may be cleared with a stripping comb. The ejected cubes fall on to a ramp and roll into a reception hopper built into the foot of the chart.

A simpler and cheaper form using ¾ in. long pegs which sit astride the grid, the grid being mounted ¼ in. forward of a fixed backboard, may be built up on a unit construction method to any size desired by a customer. By this method, a 100-subject chart of 120 columns across, giving 12,000 plotting holes, would require slightly less than one square yard of wall space.

The grid sections are manufactured by Souplex, Ltd., Morecambe, Lancs, using a 4-oz. machine and a two-impression tool, made by the same company.

Isoflex insulation.

Holder for Diamond Files

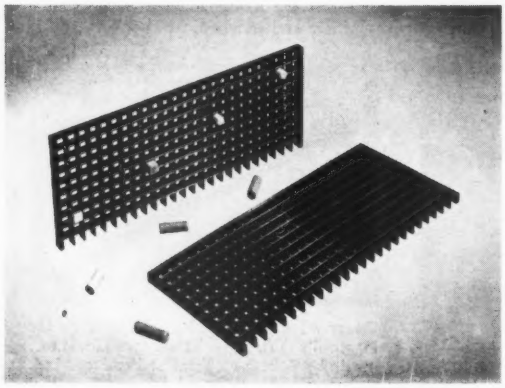
A German firm, E. Winter and Sohn, of Hamburg, 19, is supplying a plastic holder with a plastic split-two-jaw collet and a plastic cap-nut, for their diamond files, made by the electrolytic process. This brings a considerable improvement since, with the help of the holder, files can be exchanged quickly.

Food Container

The Plastics Division of E. K. Cole, Ltd., Southend, Essex, have introduced a new item in the Ekco Gold Seal domestic ware range —a Handicaddy. Injection-moulded in ivory-coloured, shock-resisting co-polymer styrene, the container is supplied with a tight-fitting lid, available in either red, blue or green.

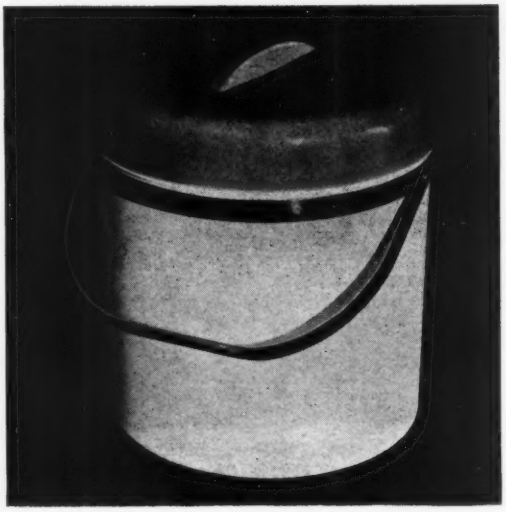
Insulation Materials

The photograph (left) shows the cutting and fixing of Isoflex thermal insulating material into a Humber Super Snipe, part of an order for five, intended for use in the Far East. The work is being carried out by Thrupp and Maberly, Ltd., of Edgware Road, Cricklewood, London, N.W.2. The material has been specified as suitable for insulating the roof and upper sides of these five vehicles. It is manufactured by B.X. Plastics, Ltd., of Chingford, London, E.4.



(Left) Visual charting system introduced by E. M. Butler, Ltd.

(Right) Food container, by E. K. Cole, Ltd., measuring 7⅝ in. high by 7¾ in. diameter.

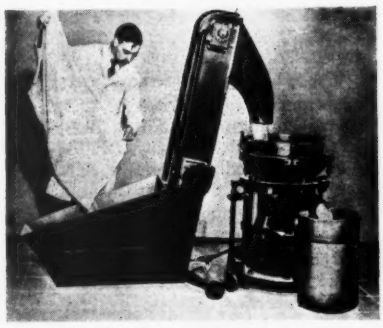


Plastics NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes

TOOL AND DIE MILLING MACHINE.—Designed for the rapid and economical production of plastics moulds, metal patterns, die casting, and small drop forging dies the new 8-in. by 18-in. tool and die milling machine made by Cincinnati Milling Machines, Ltd., Tyburn, Birmingham, 24, is the outcome of an extensive survey into the most desirable features required for the production of moulds and dies. A number of improvements have been incorporated including an extra-sensitive hydraulic tracet mechanism. The general structure of the machine is of the knee and column type with a turret and ram type mounting for the spindle head.

NEW ELEVATOR.—A new elevator designed for industries where powdered materials or granules have to be fed to ancillary processing machinery at predetermined rates, has been made by Russell Constructions, Ltd., Russell House, 8 Adam Street, London, W.C.2. It has a maximum delivery rate of about 5 tons per hour and the controlled output is obtained by means of a variable gear. The conveyor belt is of rubber into which stainless steel flights have been bonded. This arrangement eliminates a large proportion of the noise and facilitates cleaning of the machine. A ½-h.p. electric motor supplies the power.



The new Russell Elevator.

ELECTRONIC MOISTURE METER manufactured by Shaw Electronics, 31 Market Street, Bradford, York, utilizes modern circuitry and very high-frequency radio radiation, to determine accurately the dielectric or propagation constant of a material. This is directly related to the moisture content. The range of readings is from completely dry to 100% water.

BOFORS EXTEND PLASTICS PROGRAMME.—The well-known Bofors Company is extending its activities in the plastics field notably with glass fibre reinforced laminates. Its plant at Tadaholn has recently been extended and the company has been collaborating closely with AB Malmo Flygindustri (MFI) who are widely experienced in the glass fibre field. Its affiliated company AB Victory-Production is European pioneer in the continuous manufacture of glass fibre reinforced plastics bars.

NEW EXPERIMENTAL AND DEVELOPMENT ESTABLISHMENT.—To meet the increasing demand made on their Flexibles advisory service, Compoflex Co., Ltd., have opened a new experimental establishment at Godalming in Surrey. In addition to a fully equipped laboratory the centre is divided into three main sections for experimental hose making, plastics extrusions and hydraulic investigations.

MONSANTO CHEMICALS, LTD., REPORT FOR 1954.—A net profit of £806,499, an increase of 20% over 1953, is shown in the annual report of the directors published recently. The chairman in his statement commented on the expansion programme now being carried out where increased production of certain chemicals, resins, and also polystyrene, is now becoming available.

MR. EDWARD A. O'NEAL, chairman of Monsanto Chemicals, Ltd., has been elected to the board of directors of Monsanto Chemical Company, U.S.A. He has been appointed to the executive offices of the president as a functional vice-president where his duties will include the integration of the overseas activities with those of the rest of the company.

MR. FRANK G. RICE has been elected president of the Society of the Plastics Industry (Canada) Inc. Mr. Rice is manager of plastics in the chemicals department of Du Pont Company of Canada, Ltd.

PURE CHEMICALS, LTD., PLASTICS DIVISION.—Mr. H. Verity Smith has been appointed manager of this division which has been formed to develop the sales of the company's range of chemicals for the plastics industry.

NEW APPOINTMENTS AT HOWARDS OF ILFORD, LTD.—Mr. R. Vernon Harcourt has been appointed sales manager, solvents and technical chemicals department, and Mr. R. F. York has been appointed assistant manager.

COUNCIL OF INDUSTRIAL DESIGN STAFF APPOINTMENTS.—The Council of Industrial Design has recently reorganized its industrial division staff and has made three new appointments. Mr. Alec Gardner Medwin, who since November, 1948, has been the industrial officer mainly concerned with the furniture industry, has been given general responsibility for the Council's approach to the furnishing trades and personal responsibility for the Council's relations with the pottery and glass industries. Mr. Dan Johnston has been appointed industrial officer with special responsibility for textiles of all kinds, wallpapers, carpets and other floor coverings. Mr. Christopher McGeoghegan has been appointed industrial officer for furniture, woodware and leather goods. Mr. George Williams, an industrial officer since December, 1948, will have general responsibility for the Council's relations with the light engineering industries, and personal responsibility for domestic appliances, light fittings, hardware and street furniture. Mr. Tom Gregson has been appointed industrial officer for cutlery and flatware, silver and other metal hollow-ware, and clocks and watches. As already announced, Mr. Paul Reilly, the Deputy Director, heads the Industrial Division of the Council.

DESIGN AT THE PLASTICS EXHIBITION.—The design committee of the Plastics Institute have arranged for a special display of well-designed articles to be selected from those on show at the British Plastics Exhibition. The initial selection will be made by a team from the design committee during the first day and in the evening an independent panel of experts, consisting of Mr. Misha Black, Sir Francis Meynell and Sir Gordon Russell, will make the final selection. For large articles photographs or scale models will be utilized.

"GLASS FIBRE IN USE" is the title of an article by Mr. F. C. Ashford appearing in the April issue of *Design*. In it the author discusses present and possible future uses of glass fibre reinforced plastics from the designer's viewpoint.

WORK STUDY CONFERENCE AND FACTORY EQUIPMENT EXHIBITION.—The B.P.C. Work Study Conference which was held in conjunction with the Factory Equipment Exhibition was well attended, applications for tickets being double the seating capacity. Half of each of the two days was devoted to case histories of the practical application of work study in different industries and provoked lively discussion.

The Factory Equipment Exhibition showed several uses for plastics materials. Emphasis was on protective clothing with nylon, Terylene, and polythene for overalls; p.v.c. for masks, gloves, and aprons; acetate and acrylic sheet for goggles. A nylon tow-rope with a breaking strain of two tons, plastics insulated cables, and the more general use of plastics in office equipment were a feature of the exhibition.

"NYLON GOES TO WORK" is the title of a booklet published by British Nylon Spinners, Ltd., and it illustrates the many and varied fields where the fibre has proved its worth.

RIGID P.V.C. IN THE ELECTRO-PLATING INDUSTRY.—Ducting fabricated from Geon rigid p.v.c. has been installed in an electro-plating shop. The choice of p.v.c. for this job was arrived at because of its resistance to acid corrosion and the ease with which it is fabricated. The method of joining was by hot gas welding and the unit was built by Plastics Constructions, Ltd.

Mr. D. L. Capon.

NEW APPOINTMENT.—The Plastics Division of E. K. Cole, Ltd., has appointed Mr. D. L. Capon as assistant sales manager, proprietary lines.

RETIREMENT.—Mr. W. W. Wood has retired from the position of general manager of Pirelli-General Cable Works, Ltd., but remains a director of the company. His place has been taken by Mr. J. R. Harding, the assistant general manager of the overhead lines department, deputy manager of the rubber cables sales department and joint manager of paper cable sales department.

NEW DIRECTORS AT METROPOLITAN-VICKERS.—Mr. J. P. A. Meldrum, manager, home sales, and Mr. R. H. S. Turner, works manager, have been appointed directors of Metropolitan-Vickers Electrical Co., Ltd.

MR. D. J. SAUNDERS, formerly a principal scientific officer in the Rocket Propulsion Department of the Ministry of Supply, has joined the Compoflex Co., Ltd., as chief development engineer (hydraulics).

F. A. KETCH & SON, LTD., announce that after 40 years they have closed their Birmingham premises. All production is being carried out at their new factory at Trent Valley Works, Lichfield, Staffordshire, where there is ample facility for extra extensions. The telephone number has been changed to Lichfield 3591/2.

MR. T. A. MASON has been appointed a director of both A. Boake Roberts and Co. (Holdings), Ltd., and its main subsidiary, A. Boake Roberts and Co., Ltd. Mr. Mason recently joined the company as works manager.

EXHIBITION.—An exhibition of Bakelite, Vybak, and Warerite was held in Birmingham. Designed to be of interest to both the general public and technologist, it demonstrated both the manufacturing processes and wide range of applications.

GLASS FIBRE LAMINATE BOATS AT GENEVA MOTOR EXHIBITION.—Following on the success of the glass fibre cruiser and dinghies at Earls Court, W. and J. Tod, Ferrybridge, Weymouth, exhibited their craft at the Geneva Motor Exhibition in conjunction with their Swiss associates Tod Marine, Ltd., S.A.

STANDARD FOR FLEXIBLE P.V.C. COMPOUNDS.—The latest standard B.S. 2571:1955, specifies three classes of compound: Class 1, compounds with specified electrical properties and having a volume resistivity not less than 10^{12} ohm-cm. at 23° C.; Class 2, compounds with specified electrical properties and having a volume resistivity not less than 5×10^8 ohm-cm. at 23° C.; Class 3, compounds for which the electrical properties are not specified. Each of these classes is subdivided into type so that in all 12 types of compounds are provided for.

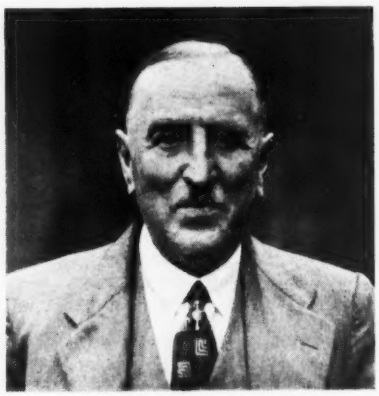
UNPUBLISHED REPORTS.—"Moisture resistance and dielectric breakdown of electrical insulating materials" is the title of report P.B. 110,797. Part of the investigation described in this report is a study of the breakdown characteristics of rigid thermoplastic materials, thermosetting materials, and laminates. P.B. 108,526, concerning pavement marking materials, is a copy of the paper presented at the Annual meeting of the Highway Research Board. IR. 11.600 deals with the addition of polyvinyl acetate resins to Portland Cement. Copies can be obtained from the Dept. of Scientific and Industrial Research, Cunard Building, 15 Regent Street, London, S.W.1.

PUBLICITY AND PUBLIC RELATIONS.—Central News, Ltd., has taken over the publicity and public relations of British Industrial Plastics, Ltd.

SOCIETY OF CHEMICAL INDUSTRY, PLASTICS AND POLYMER GROUP.—The annual general meeting of the group was held on April 19 in the rooms of the Chemical Society, Burlington House, London, W.1. The secretary's and treasurer's reports were presented.

POLYTHENE PIPING FOR WATER SUPPLIES.—An illustrated pamphlet showing the method of laying polythene water pipe by mole plough has been issued by Hellermann, Ltd., Tinsley Lane, Crawley, Sussex. Methods of jointing are also described and illustrated.

IRRADIATED POLYTHENE EXTRUSIONS.—The Anchor Plastics Company, Inc., 36, 36th Street, Long Island City 6, New York, are offering irradiated polythene extrusions. Due to limitations of equipment maximum size is 6 in. × 4¾ in., tube wall thickness .280 in., or cross section of .625 in.



Mr. William Shaw, whose death was announced in the April issue of "Plastics."

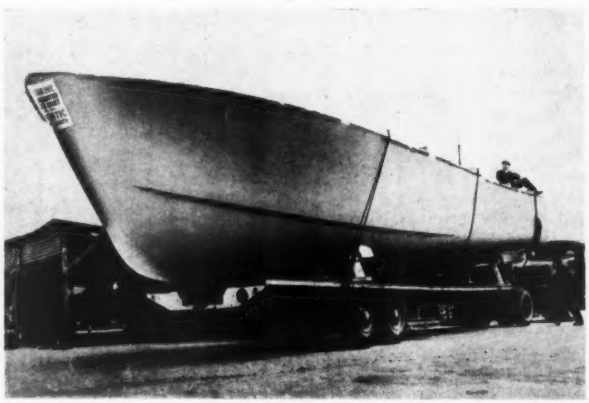
PRECIPITATED CALCIUM CARBONATE.—Data sheets describing the physical properties and chemical analysis of the vacuum grades of this material have been published by the manufacturer, John and E. Sturge, Ltd., 1 Wheeleys Road, Birmingham, 15.

FILM CATALOGUE.—A new catalogue of films which are available on free loan to responsible organizations has been published and copies can be obtained from Petroleum Films Bureau, 29 New Bond Street, London, W.1.

PRODUCTIVITY IN THE PHARMACEUTICAL INDUSTRY.—The latest B.P.C. report reviews the pharmaceutical industry and the advances which have been made in the past 20 years. One of the big problems facing the industry is the enormous number and variety of packages required. Copies of the report can be obtained from the British Productivity Council, 21 Tothill Street, London, S.W.1, price 2s. 3d.

LYONS INTERNATIONAL FAIR took place from April 16 to April 25. Among the British firms exhibiting were Peco Machinery Sales (Westminster) Ltd., showing moulding and extruding machinery and Selcol Products Ltd., the toy manufacturers.

INDUSTRIAL SOLVENTS AND FLAMMABLE LIQUIDS.—A booklet published by the Fire Protection Association, 15 Queen Street, London, E.C.4, gives a list of the properties of these materials most useful in assessing the fire hazard.



The 54-ft. glass fibre/resin laminate hull recently completed by Halmatic Ltd. Probably the largest plastics moulding in the world, its weight is 6,000 lb.

The Duke of Edinburgh inspecting products made with epoxy resins at Aero Research Ltd. (Left to Right): Mr. R. H. Wilson, H.R.H., Dr. N. A. de Bruyne, Mrs. Raymond Needham, Dr. R. Käpeli, (back to camera) Mr. Raymond Needham, Q.C., and Mr. R. F. G. Lea.

DUKE OF EDINBURGH VISITS AERO RESEARCH, LTD.—A special display commemorating the 21st anniversary of Aero Research, Ltd., Duxford, Cambridge, was visited by H.R.H. The Duke of Edinburgh. The display showed many examples where synthetic resins, for which Aero Research, Ltd., are well known, have been advantageously employed. His Royal Highness was presented with polo sticks made with Araldite epoxy resins, while on behalf of Prince Charles and Princess Anne he accepted a radio-controlled motor cruiser and a scale model of his yacht "Cowslip" both glued with Aerolite.

POLYSTYRENE MOULDINGS.—Advice on methods to ensure satisfactory results in polystyrene moulding processes is contained in a booklet, "A Code of Practice for the Annealing of Polystyrene Mouldings," published by the British Plastics Federation, 47-48 Piccadilly, London, W.1, price 4s. Factors which contribute to the crazing of polystyrene during moulding are described and also methods of relieving strain. Only the general-purpose grades of polystyrene are considered.

BOARD CHANGES AT STYRENE PRODUCTS, LTD.—Following the acquisition of Petrochemicals by Shell Chemicals, Ltd., Mr. Godfrey H. Owtram, Mr. E. J. Barnsley and Sir Robert Robinson, all of whom recently resigned from the Petrochemicals Board, have also resigned from the Styrene Products Board. They have been succeeded by Mr. A. D. Koeleman, Mr. W. F. Mitchell, and Mr. L. H. Williams, all of Shell. The Erinoid Directors, Mr. H. E. Harden and Mr. J. Harvey, remain on the Styrene Products Board and Mr. P. C. Chaumeton continues as managing director.

MECHANICAL THERMOMETER DIVISION.—Cambridge Instrument Co., Ltd., have decided to make their North Finchley factory a self-contained unit dealing with their business in thermometers of various types, automatic temperature regulators and pressure and vacuum dial gauges and recorders. Correspondence relating to these instruments should be sent to Cambridge Instrument Co., Ltd., Mechanical Thermometer Division, Friern Park, North Finchley, London, N.12.

HIGH VACUUM AND PRESSURE IMPREGNATION PLANTS. — Blickvac Engineering, Ltd., have redesigned their range of vacuum and impregnating plants. Improvements include centralized controls, easy access to pipes for cleaning and "floating" pipe lines to avoid all risk of fracture. Specially adapted plants are available for use with epoxy and other potting resins. Further details can be obtained from the company at 96 Aldersgate St., London, E.C.1.

FINNEY PRESSES, LTD., announce that they have been granted licence to manufacture in Britain, the plastic, rubber and continuous vulcanizing machinery which includes a full range of ancillary equipment, including those items specially developed for the wire insulating industry, produced by Davis-Standard Sales Corporation of Mystic, Connecticut, U.S.A. The company is to market this range of machinery in Europe and throughout the sterling area. Mr. H. M. Whitcut is to join Finney Presses, Ltd., to promote this phase of the company's activities.

REVISED STANDARDS.—The series of five British Standards (B.S. 517, 521, 522, 523, 524) dealing with cresylic acids and phenol has been revised to bring the specification up to date, particularly with regard to methods of test. In British Standards 517, 523 and 524, the "specification" clauses remain unchanged from the 1948 edition. In B.S. 521, the five well-established grades of cresylic acid have been redefined so that the maximum meta-cresol content for Grade A is now 60%. In B.S. 522, a third grade (Grade C) of ortho-cresol has been added, having a crystallizing point between 28.3 and 29.3° C.

The British Standards Institution also announce the publication of a revised edition of B.S. 1524. The 1949 edition classified the material in accordance with the softening point, but this method of classification has now been discontinued in favour of the flow temperature, which has been found more convenient. Additionally, the temperature and humidity of the atmosphere used for conditioning have been changed to 23° C. and 50% relative humidity respectively. The 1949 edition was based on statistical principles, but due to the new method of classification and the additional tests which have been included, it has not been found possible to lay down statistical limits in this edition. The document provides for five types of material which are classified by their flow temperatures.

Copies of these Standards may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1. Prices: B.S. 517 and 521, 5s.; B.S. 524, 4s.; B.S. 522 and 523, 3s.; B.S. 1524, 6s.

RETIREMENT.—Mr. G. W. Wadsworth has retired from the post of buyer for H. D. Symons and Co., Ltd. He has been succeeded by Mr. C. W. Shuttleworth.

BAKELITE, LTD., announce that in spite of the explosion which occurred in the vinyl resin plant at the Aycliffe works of Bakelite, Ltd., on April 19, the company expect to maintain continuity of supplies of materials made at this plant. The explosion will have no effect whatsoever on the Bakelite, Ltd., works at Birmingham, which will continue normal manufacture and delivery of phenolic and urea moulding materials, laminates and resins, adhesives and other phenolic and urea products.

Some of the principal guests at the Annual Luncheon of Midlands Section of the Plastics Institute. (Left to Right): Mr. A. E. Skan, Mr. A. W. Sherwood, Professor Bodkin, M.R.I.A., M.A., D.Litt., Ald. Griffiths, Mr. H. N. Davies and Mr. H. F. Wilson.

BRITISH XYLONITE DIVIDEND.—Recommended dividends for 1954 are Preference shares 2½%, making 5% for the year and Ordinary stock 9%, making 11% for the year. The Group trading profit after tax deduction is £360,726 against £177,954 in 1953. The annual general meeting of the company is to be held on May 31.

E.R.A. PUBLICATIONS.—The Electrical Research Association has recently published five technical reports, copies of which can be obtained from the Association at Thorncroft Manor, Dorking Road, Leatherhead, Surrey. The titles of the reports are: L/T282, The Measurement of Power Loss at Temperatures up to 100° C. and Frequencies up to 100 Mc/s., price 7s. 6d., postage 3d.; L/T286, The Dielectric Properties of Acenaphthylene Styrene Co-polymers, price 3s., postage 3d.; L/T292. Further Improvements to the Vacuum Torsion Balance and Sorption Measurements on Polystyrene, price 10s. 6d., postage 3d.; L/T303, Growing of Perovskite-type Crystals, price 7s. 6d., postage 3d.; L/T310, Breakdown of Solid Dielectrics in Divergent Fields, price 21s., postage 4d.

MR. F. S. MILLS has been appointed sales manager of Acheson Colloids, Ltd., Dispersed Pigments Division.

Mrs. Robertson, wife of the High Commissioner for Canada, and Mr. Gardner-Medwin examine a picnic case chosen for the Board of Trade's "Modern U.K." stand at the 1955 Canadian National Exhibition.

P. C. Allen
Retiring chairman of the Trustees of the Plastics Industry Education Fund.

SIR,—*Through the medium of the pages of "Plastics," we wish to appeal on behalf of the Plastics Industry Education Fund for additional income to make possible a large and rapid extension of the valuable work of this Fund.*

At the moment, our annual income is no more than £5,000 per annum, which is mainly disbursed in the form of training grants to enable young people in the industry, and those about to enter it, to make an intensive study of science or technology related to the industry, to provide bursaries at two of the leading centres of technological education, and to provide publications and text books.

The value of this work cannot be overestimated, affecting as it does the whole future of this young industry which, great as it is, is still only in its infancy.

Of all the companies engaged in it, only about a quarter are at present subscribers to the Fund. To those companies we would most earnestly say—please double your contribution, it will be worth it. To those who have not yet subscribed we say—give us your support, help us to train the young men and women who will help to keep the British plastics industry in the forefront.

P. C. ALLEN.
C. S. DINGLEY.

C. S. Dingley
A Trustee since the inception of the Fund, Mr. Dingley now takes over as chairman.

The above letter has been received from Mr. P. C. Allen and Mr. C. S. Dingley; an account of the work of the Fund can be found on page 144 of this issue.

BEXTRENE B.C.15.—B.X. Plastics, Ltd., announce a new high-impact polystyrene co-polymer moulding compound. Four times as strong as the Bextrene general purpose material, B.C.15 has an Izod value of 1.5 ft./lb. per in. of notch on a typical moulded specimen. The material has excellent flexural and moulding properties.

NEW RESEARCH CENTRE FOR T.I.—Tube Investments, Ltd., have announced senior appointments to the company's new research laboratories at Hingston Hall, near Cambridge. Dr. F. P. Bowden, F.R.S., of Cambridge, has been appointed chief research consultant, and is in charge of the laboratories. Also of special interest to the plastics industry are the appointments of Dr. A. Charlesby, late of the Atomic Research Establishment, Harwell, and Mr. J. E. Gordon, late of the Chemistry Department, Royal Aircraft Establishment, Farnborough. These men are amongst the leaders of their field. Other leading scientists to join the staff are Dr. J. W. Mentor, Dr. E. W. Rowe, and Dr. R. T. W. McLoughlin, all of Cambridge University, Dr. D. W. Pashley, of London University, Mr. R. Worral, of Birmingham University, and Mr. A. P. Green, of the Iron and Steel Research Association.

METHYL ETHYL KETONE PRICE REDUCTION.—A reduction in price of £5 per ton is announced by Shell Chemicals, Ltd., and British Industrial Solvents on methyl ethyl ketone.

NEW BRITISH VINYL ACETATE PLANT.—A large plant for the manufacture of vinyl acetate is being constructed at Salt End, Hull, by the recently formed company Hedon Chemicals, Ltd. Hedon Chemicals, Ltd., is a company jointly owned by The Distillers Co., Ltd., and Shawinigan Chemicals, Ltd., of Montreal, Canada. Sales will be handled by Shawinigan, Ltd., of London, and British Industrial Solvents—a division of The Distillers Co., Ltd. The directors are: Mr. J. M. Rimington, Mr. W. E. Cash, Mr. J. H. Dunn, Miss H. M. Hyatt, Dr. R. S. Jane Dr. H. S. Sutherland, Mr. G. Benson, and Mr. A. W. Scott.

NEW APPOINTMENT.—Mr. R. J. Dixon has been appointed a director of Wickman, Ltd., machine tool manufacturers. Mr. Dixon is the chief engineer of the company.

PLASTICS INSTITUTE GOLFING SOCIETY.—The first meeting this year of the Society took place at Hendon on April 19. Results:—"Robert Hartley" Prize (stroke): Winner, C. E. Bennett (14), 73; runner-up, R. P. Anderson (12), 75. "Austerity" Cup (scratch prize): Winner, Charles Parkinson (5), 81. "Styrene Products" Prize (Stableford Bogey Greensomes): Winners, R. F. Johnson (8) and C. Parkinson (5), 32 pts.; runners-up, S. J. Skinner (12) and R. McEwan (8), 30 pts.

"Plastics in the Service of Man"

The following is a list of full names and addresses of companies mentioned in the illustrated feature "Plastics in the Service of Man," which appears on pages 140 and 141 in this issue:—

57. Plastics in the Brewery and Distilling Industry—2

B.X. Plastics, Ltd., Higham Station Avenue, Chingford, London, E.4.

British Celanese, Ltd., 22 Hanover Square, London, W.1.
British Rawhide Belting Co., Ltd., 246 Gt. Portland Street, London, W.1.
Coin Insulation, Ltd., Courtenay Road, Woking, Surrey.
Formica—Thos. De La Rue and Co., Ltd., 84-86 Regent Street, London, W.1.
Gravfil Machines, Ltd., 88 Gray's Inn Road, London, W.C.1.
Halex, Highams Park, London, E.4.
Helenaware, Ltd., 3 Vere Street, London, W.1.
Horwitch, Smith and Co., Ltd., 42 Lower Loveday Street, Birmingham, 19.
Pearce Signs, Ltd., London, S.E.14.
Perspex—I.C.I., Ltd., Plastics Division, Black Fan Road, Welwyn Garden City, Herts.
Triplex Safety Glass Co., Ltd., 1 Albemarle Street, London, W.1.
Warerite—Warerite, Ltd., Watton Road, Ware, Herts.
Watney, Combe, Reid and Co., Ltd., Allington Street, Pimlico, London, S.W.1.

MEETINGS

May

18th.—Annual general meeting. Plastics Institute, Yorkshire Section.

24th.—Annual general meeting, annual luncheon and works visit. Plastics Institute, Western Section. 12 noon.

June

2nd.—"Leo Hendrik Baekeland and Photographic Printing Papers," Dr. C. E. K. Mees. Society of Chemical Industry, Plastics and Polymer Group, Royal Institution.

17th.—Ladies' Night. Society of Chemical Industry, Plastics and Polymer Group, The Casino, Taggs Island.

TALKING SHOP . . .

Plastics Institute, London Section. The annual general meeting of the London Section of the Plastics Institute was held at the Waldorf Hotel on April 25. Over 200 members had balloted for the election of three new members of the committee, to be selected from seven candidates. This resulted in the election of Dr. E. C. Child, division leader, technical service and development department, plastics division, I.C.I., Ltd.; Mr. D. S. Mahon, sales development manager, Bakelite, Ltd.; and Dr. E. S. Narracott, plastics division, Shell Petroleum Co., Ltd. .The retiring members, Mr. H. A. Brooks, B.I.P. Chemicals, Ltd., and Mr. Chamberlain, Shell Chemicals, Ltd., were thanked by the chairman, Mr. M. P. Brown, for their valuable services.

The annual meeting is also the time when the chairman relinquishes office to make way for the new chairman who will preside at the activities of the section for a period of a year. Mr. T. C. Corbett was unanimously elected chairman, and spoke warmly of the successful administrations of Mr. Brown during his term of office in 1954-55.

Mr. C. W. Oakhill, the hard-working secretary of the London Section, was unanimously requested to proceed with his good work.

The meeting was extremely well attended and indicative of the vigorous expansion of the London Section.

* * *

Practical Strength of Polystyrene. Following the A.G.M., noted above, Mr. M. P. Brown read a paper entitled "Practical Strength of Polystyrene." He had a large number of moulders in his audience, together with representatives of raw material manufacturers.

Indeed, Mr. Brown's address was strictly practical; he inclined towards the manual method of testing the impact strength of a moulding, that is by repeatedly hurling it to a concrete floor, in preference to the Izod and other methods approved by the B.S.I. and A.S.T.M. There is no doubt that until the testing field has undergone a very thorough tidying process, the moulder will prefer such arbitrary, even primitive, methods of evaluating physical properties of moulding compounds. At the moment, figures published by the materials manufacturer often tend to confuse the moulder, and certainly there is a great need for standardizing test procedures.

An example of this need was given by Mr. Brown when referring to the Kerosene test for crazing in polystyrene. Quite apart from the grade used, the temperature of the Kerosene will influence the test results. Unless a clear standard is laid down, the test as such becomes valueless.

The hard core of Mr. Brown's paper was the loss of mechanical strength of a polystyrene moulding at elevated temperatures. At anything above room temperature, polystyrene rapidly loses strength, particularly impact; the loss is such that very serious consideration should be given to a moulding which is required to withstand temperatures above this level and at the same time to support a load.

The importance of this point was not lost upon the audience. Several comments were made which showed that the moulder appreciates a frank appraisal of the true worth of any material.

* * *

A Plastics "Wind Tunnel." Following his lecture, Mr. Brown showed a film just received from the Dow Company in America, made in the Styron laboratories. As a first showing to English audiences, it may be that April 25 will become an historic date. The Styron film shows the moulding of a flat disc; the tool itself has been fitted with glass-filled apertures, one on each side, one side being illuminated and the other side being the focal point for a slow-motion camera. For the first time it is possible to see what happens at the point of injection of the molten plastic material into a mould cavity. The experiment was repeated several times over, each at varying rates of injection. The glass-clear styrene was loaded with a small quantity of tracer die, and in some cases inserts of various profiles were positioned, to demonstrate quite clearly the effect upon the flow of the material when coming into contact with an obstruction.

Perhaps we may take comfort from the fact that conjectures as to what happened in the tool during the moulding cycle have been proved right by this visual demonstration. None the less, the continued use of a tool of this kind not only assists research tremendously, but also provides an invaluable aid to the teaching of plastics technology. If we learnt nothing else at the meeting, we could at least infer that the shank on a threaded insert could well be shaped to an aerofoil section to reduce or eliminate weld marks and consequent weaknesses in transfer or injection mouldings. And we have, for the first time, a "wind tunnel" for the plastics industry, a mould in which we can see what happens during the actual cycle.

* * *

Mr. Mitchell and the Germans. Some 12 months ago we reported the comments of Mr. C. J. F. Mitchell, managing director of Wallington, Weston and Co., Ltd., of Frome, when speaking at the annual dinner-dance of the company's Foremen's Club. At that time Mr. Mitchell had some astringent comments to make on the unfair German competition with which his company, in common with many others in the plastics industry, was faced.

This year Mr. Mitchell has again returned to the charge and a full report of his speech was published in the *Somerset Standard* for April 15. His main points were the unfair ratios of tariffs, vis-à-vis Germany and Britain, and the rebate German manufacturers obtain on exports they secure, which often means from 8% to 10%.

Rearguard Action. Reported in the *Eastern Evening News* for April 16 was the fourth annual conference of the British Boot and Shoe Institution, held at the Devonshire Hall, Leeds. Once again the need on the part of the boot and shoe industry to watch plastics developments was stressed, and once again leather manufacturers had their say on competition from plastics. I can find no statement on this occasion, however, which offered a criticism of plastics materials; this is a change because, in the past, representatives of the leather industry, unanimous in their objection to synthetics, have sought to prove that plastics in shoes are bad for the feet, æsthetically wrong and, most probably true of all, bad for the leather industry.

* * *

Deckchairs and Plastics. When you pay your penny, or whatever the charge is, to sit on your deckchair on the beach at Bridlington this summer, you will be shaded from the sun by bright-coloured sunshades made of a plastic material. In addition, about half of the 8,000 deckchairs owned by the Bridlington Council have been fitted with a plastic material instead of canvas. The *Bridlington Free Press*, reporting this development on March 25, did not say what the material was that was being used.

* * *

New German Polythene Plant. The *Financial Times* for April 23 announced details of a new plant to go into production in 1957. Located at Gelsenkirchen, on the Rhein-Herne Canal, the project will cost between 5 and 6 million pounds sterling and will be operated by a new company, Kohl-Oel Chemie; three German concerns have taken a one-third interest each. Fabwerke Hoechst, already famous in plastics, Mannesmann, the Ruhr steel combine, and Deutsche-Erdoel. The new organization has been capitalized at DM. 15M.

This plant will operate the patents, although not exclusively of Professor Ziegler, of the Max Planck Institute. By using a new type of catalyst, polythene will be made at normal pressures instead of the 1,000 to 1,500 atmospheres at present employed. Not unexpectedly, the new process should result in a cheaper form of polythene.

The Ziegler patents have also been leased to another group in Germany, "Working Group Olefine Chemistry," a joint venture of several coalmining companies.

I understand that we shall be seeing some of the Ziegler polythene at the British Plastics Exhibition next month. T.I. Plastics, Ltd., a recently formed offshoot of the T.I. Group, will be showing samples of extruded Ziegler polythene on their stand. Examination by experts will indicate to the man in the street the relative merits and differences in properties, if any, between the low-pressure and high-pressure produced materials.

For the student of plastics, the situation offers a new aspect of our industry. Rarely, if ever, since its inception has the industry seen the basic manufacturing technique for any given material changed in such a radical manner.

PLASTIKON

The Properties and Testing of Plastics Materials—Part 2 (Cont.)

Section 2. Compressive, Shear, Bearing, Cross-breaking and Bursting Strength

By A. E. LEVER,* A.I.R.I., and J. RHYS,† M.Sc.

Continuing this series on the properties and testing of plastics materials the authors deal in this section with compressive strength. The information is supplemented with a bibliography and a table of compressive strengths for a wide range of plastics.

Compressive Strength

THIS is defined (1) as the maximum compressive stress carried during a compressive test (p.s.i.). It may, or may not, be at the point of rupture.

It is calculated by dividing the maximum compressive load carried by the specimen during the test by the original cross-section area of the specimen.

Compressive stress is the compressive load per unit area of the original cross-section carried by the test specimen at any time during the test (p.s.i.).

Compressive strain is the ratio of the deformation to the original length of the measured compressing section, i.e. change in length per unit of original length (%).

Elastic modulus is the ratio, within the elastic limit of compressive stress, to the corresponding compressive strain.

In the case of a material that fails in compressive strain by a shattering fracture, the compressive strength has a definite value.

In the case of those materials which do not fail by shattering fracture, the value obtained for compressive strength is of arbitrary value, depending on the degree of distortion that is regarded as indicating complete failure of the material.

Many plastics will continue to deform in compressive strain until a flat disc is formed, the compressive strain rising steadily without any well-defined fracture. Compressive strength can have no real meaning in such cases.

The shape of the test piece is of importance, as a test piece of one shape may deflect more than a test piece of another shape. For pieces having parallel loading faces, and sides normal to the loading faces, the influence of shape may be expressed in numbers as the "shape factor" (2). This is defined as the ratio of the area of one of the loaded surfaces to the area of all of the unloaded, surfaces which are free to bulge. Specimens having the same shape factor and composition, regardless of their size and shape, will require fairly closely the same compressive stress to produce a given percentage deflection.

The conditioning of the test piece is also of great importance, and is chosen on the basis of the rapidity with which the compressive properties of the material in question vary with the changes in atmospheric humidity and temperature. With cellulose acetate they change quite rapidly, whereas with polystyrene they are slower.

A machine is described (3) which autographically records the force to which a specimen is subjected when deformed cyclically in compression. The frequency range covered is 0.0005 to 1,500 c.p.m.

In designing test specimens for compressive strength tests, two opposing effects have to be considered (4). The more important is the Enler buckling stress, which is a function of the length of the specimen, the radius of gyration of the cross-section, and the end-loading conditions.

The other factor is the actual restraint from swelling under the compressive load which is applied by the friction on the ends of the test piece. This effect is less marked as the distance from the ends increases and, therefore, calls for a specimen as long as possible.

For plastics, a specimen having a length three times the side of the square cross-section gives reasonably satisfactory results. The ends should be machined truly flat and square and parallel to each other. This is important.

It is shown that filled urea and phenolic mouldings are left in a state of internal stress by compression moulding procedures (5), and that subsequent heat and moisture conditions tend to accentuate this. A method is described for determining these residual stresses. There is a bibliography.

Shear Strength

This is the maximum load required to shear the specimen in such a manner that the moving portion has completely cleared the stationary portion. It is expressed in p.s.i. based on the area of the sheared edge or edges (6).

Shear Stress

This is the load per unit of cross-sectional area tending to cause a body to fail in the plane of the applied stress. There is a useful discussion (2) of the relative merits of compression and shear in design and shape factor as applied to natural rubber. The stress-strain curve in shear is substantially linear up to the maximum stresses usually employed.

There are several methods of applying shear (4):—

(a) One is to take a sheet and apply a compression load along one diagonal and a tension load along the other, since shear in a panel may be resolved into equal compression and tension forces acting at right angles to each other. It is difficult, however, to obtain results which are not masked by effects due to the system of holding the edges of the panel, and fairly wide deviations occur.

(b) Another method is to apply shear in the form of a torque on a round tube. This is excellent for materials which can be extruded or fabricated in that form.

(c) An American specification (7) covers the punch type of shear test for plastics in the form of sheets and moulded discs from 0.005 in. to 0.500 in. thick.

A British specification (8) for synthetic-resin-bonded paper laminates for electrical insulation also uses the punch type of shear test. Details of the punch and die used are given.

(d) A method is described (9) for measuring shear moduli and losses of elastomers in a range of frequencies of about $1\text{-}10^4$ and from 10 cps. downward. It also provides for large cyclic shear stresses and deformations without employing reasonance methods. Only one sample is needed for a complete study.

An absolute hysterometer has been developed for determining the hysteresis under conditions of torsional shear (18).

Cross-breaking Strength

This may be defined as the load required to fracture, by bending, a bar-shaped test piece of given rectangular cross-section, when it is supported horizontally, and the load applied vertically in one of the following forms of test:—

(a) Cantilever Test. The bar is held by a clamp at one end and the load applied at a given distance from the near edge of the clamp.

(b) Three-point Loading Test. The bar is supported at two points, a given distance apart, and the load applied midway between them.

The second method is used in a specification for electrical materials (10), and the first method is used for testing ebonite (11).

For laminates method (b) is used (12). The distance between the supports shall be 16 times the thickness of the specimen and the load applied at such a rate that the specimen fractures in 15 to 45 seconds.

$$\text{Modulus of Rupture (p.s.i.)} = 3 \times \frac{\text{breaking load—lbs.}}{\text{breadth—ins.} \times \text{depth}^2\text{—ins.}} \times \text{length between supports ins.}$$

(c) Four-point Loading Test. This is used in the Martens Test, and makes use of a four-point loaded beam.

Bursting Strength

The resistance of round, rigid tubing to rupture by internal hydrostatic pressure is covered by specification (13).

The difficulties of determining the bursting strength of materials with a high elongation can be avoided by using a circular test piece and clamping it into a bell-shaped attachment which is fixed to a

* Consultant. † Senior Lecturer in Plastics, National College of Rubber Technology.

Mechanical Properties of Plastics — Compressive Strength.

Typical Data	Compressive Strength p.s.i. $\times 10^3$
Phenol formaldehyde:	
Type G	28
Type MS	30
Type HS	20
Type HR	15
Phenol formaldehyde laminates:	
Paper	30
Fabric	40
Cast phenolics	30
Urea formaldehyde:	
Paper filled	30
Wood filled	30
Urea formaldehyde laminates:	
Paper	35
Fabric	40
Melamine formaldehyde	30
Melamine formaldehyde laminates:	
Paper	40
Fabric	45
Polyesters: unfilled	21
Polyester glass laminate:	
Rovings	70
Cloth	30
Mat	25
Cellulose nitrate	10
Cellulose acetate	14
Cellulose acetate—butyrate	12
Ethyl cellulose	10
Polyethylene	—
Polytetrafluorethylene	1
Polyvinyl chloride (P.V.C.):	
Rigid	10
Plasticized	1
Polyvinyl chloride—acetate:	
Rigid	9
Plasticized	1
Polyvinylidene chloride	15
Polystyrene	13
Polystyrene (and alloys):	
High impact	6
Polymethylmethacrylate	12
Nylon moulding powder	14
Nylon filaments	—
Silicones (elastomeric)	—
Natural rubber	—
Hard rubber	8
Shellac	10
Casein	30
Steel	50
Aluminium	12

Schopper-Dalen bursting apparatus (14).

An electronic machine for determining the shock resistance of plastics is described (15). The resistance of a material to shock may be dependent upon factors other than those which control its resistance to impact blows imparted by a striker. Flexural shock employed in this machine is considered to be convenient and simple in operation.

A Burst Test Apparatus is described (16), consisting essentially of the bursting of a test piece by means of air pressure. Two methods are used: (a) an instantaneous burst, which is comparable to a tension test; (b) a time burst, comparable to a long time tension or creep test.

There is not a close correlation between bursting strength and tensile strength.

Bearing Strength

While it is well known that higher-strength materials will generally give higher bearing strengths, there is no satisfactory method by which bearing strength may be estimated from tensile or compressive properties.

A specification has been issued (17) for rigid plastics in sheet or moulded form. Details of the apparatus are given. There are two procedures, one for tension loading and another for compression loading.

References

(1) A.S.T.M. Spec. D.695-52T. (2) Rubber in Engineering—H.M.S.O., 1945. (3) *J. Appl. Phys.*, 1952, **3**, 285. (4) *Chem. and Ind.*, March 14, 1953. (5) A.S.T.M. Bull., 1952, No. 181, 53. (6) A.S.T.M. Spec. D.732-46. (7) B.S. 1137, 1943. (8) *Rub. Chem. and Tech.*, 1954, **27**, 385. (9) B.S. 1539, 1949. (10) B.S. 903, 1950. (11) B.S. 1322, 1946, (12) A.S.T.M. Spec. D.1180-51T. (13) *Kunststoffe*, 1952, **42**, 13. (14) *Mod. Plast.*, 1953, **30**, No. 9, 143. (15) A.S.T.M. Bull., 1947, No. 148, 64. (16) A.S.T.M. Spec. D.953-48T. (17) *India Rubber World*, 1954, **130**, 797.

PROPERTIES AND TESTING OF PLASTICS MATERIALS, PART 2 (Cont.)
SECTION 3. FLEXURAL PROPERTIES

THERE is an excellent review of the subject of flex-cracking as applied to elastomers (1) and tests are divided into three types:—

(a) Repeated Linear Extension

Dynamometer P-B (2), on which a sample is stretched and relaxed by means of a screw and tensions are read by means of a spring balance.

Martens Schopper (2), which simultaneously stretches and releases four rings. The tension is controlled by means of springs, and the rings travel over rollers during the test.

Firestone (3), on which dumb-bell test pieces are stretched by oscillating grips.

Vogt (4), which is a rocker-fatigue machine on which a strip of rubber with a hole in the centre is repeatedly stretched.

De Mattia (5), on which dumb-bell test pieces are stretched. There has been a modification of this machine (see ref 9).

(b) Repeated Bending Without Tension

India Tyre and Rubber Co. (6), on which the test pieces are flexed through 90°.

R.S.L. (Rubber Services Laboratories) (7) (8). This machine is a modification of the I.T.R. machine, so that samples are bent by contact with an idler pulley.

Monsanto Flipper is similar to the R.S.L. machine.

De Mattia (9) (5). This is a modified machine constructed so that the samples are flexed through a predetermined angle.

A simple device for the insertion of a slit in the test piece in preparation for the determination of the rate of crack growth is described (10).

Vibration Machine (11), which vibrates a sheet of rubber and measures changes in physical properties after vibration.

Graffe (12). This machine bends a strip of rubber with one end fixed.

(c) A Combination of Bending and Extension

Goodyear Pinched Strip (13), which is similar to the Vogt machine, but the sample is stretched to 60% elongation and then bent to about 45% of its original length.

Du Pont (9). This machine consists essentially of four pulleys around which a test belt is run under tension. This belt is composed of individual test pieces acting as links held together with belt fasteners.

Scott Pulley-bend Tester (5), which is primarily a ply-separation test in which strips of plied rubber and fabric are reciprocated over idler pulleys.

Pirelli (14). A rubber ring is mounted between two pulleys, one of which is driven and the other idles. The distance between them is variable.

An American specification (15) uses three machines which are used for determining the compression fatigue of vulcanized rubber: (i) **The Goodrich Flexometer**, which vibrates the test piece at constant amplitude. (ii) **The Firestone Flexometer,** in which a rotary motion is applied to one end of a test specimen held under a constant compression load and the time required for a definite change in height of the specimen is determined. (iii) **St. Joe Flexometer,** which measures the rate of heat generation and breakdown characteristic of rubber compounds when flexed under compression loads.

The I.C.I. Torsion Flexibility Test (16) studies the change in flexibility over a temperature range, but it does not measure the brittle stage.

The flexural properties of rigid plastic materials are determined by means of a special apparatus described (17).

A valuable investigation into variable factors occurring both in the testing apparatus and the material (18) used a hydraulic tester.

A variable flexure test jig is described (19) on which the specimen is tested as a simple beam loaded at the centre. The span can be adjusted to any desired value so that different thicknesses may be tested at the same span-depth ratio.

An improved electronic flexing machine for fabric and plastic film (20) permits the bending rate to be varied, and is adaptable for the determination of bending modulus.

A static impact and dynamic bend test for the assessment of the serviceability of plastic gears (21) tests the teeth of the gear. It is noted that speed is an important factor in wear. At low loads, wear increases only slowly with speed. With increased load the curves show a steeper inclination. The modulus and the number of teeth of the gears have an important influence on wear. At a speed of 890 ft./min. wear in relationship to modulus remained approximately constant, but at higher speeds wear tends to increase parabolically with increased modulus. Thus, a high modulus, combined with a small number of teeth, indicates a gear unsuitable for operating continuously at high speeds.

A method and apparatus for testing the flexural strength of plastics quantitatively are discussed (22). Specimens of 1 gm. weight can be used. This method permits more rapid tests in experimental research, eliminating the necessity of preparing large quantities of the material being investigated.

A vamp flexing machine (23) is used to assess shoe-upper materials, including rubber, to crack in the creases formed in the upper during walking.

Properties of plastic films are discussed (24) and a "folding-endurance" test is made, using the M.I.T. Tester, Method B (25).

(*Continued on page* 160)

Low-temperature Flexibility of Rubber-like Materials

By G. N. WELDING,* M.A., B.Sc., A.P.I.

The author has reviewed the situation with regard to the testing of the low-temperature flexibility of rubber-like materials. In addition he has critically assessed one of the instruments recently introduced to carry out this test. *We are greatly indebted to H. W. Wallace and Co., Ltd., who have assisted by submitting their instrument to impartial appraisal.*

New Torsion Instruments

FOR a number of years there has been need of apparatus for measuring low-temperature flexibility of materials such as plasticized p.v.c. Recently there have been marketed two British instruments for torsion tests, by the method of Clash and Berg.[1] The importance of low-temperature behaviour, methods of measurement, and features of the new instruments are considered in this review. Accuracy and interpretation of results are discussed in Appendices 2 and 3.

Low-temperature Behaviour

All rubber-like materials become rigid at low temperatures. As the temperature is lowered, the deformation of the material in response to an applied force becomes slower. Finally, at a sufficiently low temperature, the large, high-elastic deformation occurs so slowly as to be negligible during the time available. In this condition the material is frozen to a rigid, brittle glass.

Whereas rigid plastics, such as polystyrene, are glasses at room temperature, most rubbers must be cooled well below room temperature before they approach the glassy state. Loss of flexibility is a serious problem with materials which begin to stiffen at room temperature or only slightly below, such as plasticized p.v.c. compositions.

In addition to the "instantaneous" loss of flexibility, apparent as soon as the material reaches the temperature concerned, there may also be a slow decrease of flexibility on prolonged exposure to the low temperature. This can be caused by crystallization, and by incompatibility of plasticizer induced by low temperature.

Failure in Service

Flexible materials may be unsatisfactory at low temperatures merely because they become stiff. Industrial protective clothing, when used outdoors in cold weather, may be so stiff as to be unpleasant to wear.

Fracture due to brittleness is even more serious. This can occur when the material in the stiffened condition is deformed in ways which it could easily have tolerated in the flexible state. Unused plasticized p.v.c. conveyor belts for mines have become useless because they cracked when unrolled after storage above ground in frosty weather.

Simple Freeze Tests

The simplest freeze tests for flexible compositions measure the temperature at which the material either behaves in a particular way or shows a specified change from the room-temperature behaviour. Brittleness tests give the temperature at which the material cracks when subjected to a specified deformation treatment. Stiffening tests measure the temperature which produces a specified rather low flexibility, or a reduction of flexibility to a specified fraction, such as half or one-tenth, of its value at room temperature.

Flexibility and Brittleness

Flexibility tests are more convenient than brittleness tests, because they are non-destructive, which results in economy of material and reduced error of test. Also, flexibility can readily be measured over a very wide range of temperature, giving a more complete characterization than is obtainable from brittleness tests. It has been shown that changes in cold-flex temperature (e.g., as measured on the new instrument), resulting in changes in composition of a particular type of material, are accompanied by brittle temperature changes of different extent, but in the same direction.[4] It is therefore possible to avoid use of brittleness tests, except when necessary in relation to a particular application, as part of a final check on compositions developed to have suitable room and low-temperature flexibility.

Torsion Flexibility Test

Flexibility is conveniently measured in a torsion test, because the apparatus can be made simple and compact. The test-piece is a strip cut from mould sheet, or a moulded strip. For temperature control, it is submerged in circulating liquid or air, cooled by solid carbon dioxide and heated electrically or otherwise. Deformation in shear is readily calculated from angle of twist, and stress is obtained from a dead load,[1, 2, 5, 6, 7, 8, 9, 10] torsion wire,[3, 11] or balance.[12]

Operation of Torsion Test

The test measures deformability or stiffness at each of a number of temperatures. A series of increasing temperatures is preferred to a decreasing series. The increasing series gives reduced frozen stains in the test-piece,[1, 3] and temperature is readily raised as required by an electric immersion heater and controller.

The time allowed for the twist must be accurately controlled. Five seconds is generally adopted as a compromise between the requirements of experimental convenience and of closeness to service conditions.

One method of operation is to apply a constant torque and measure the angle of twist (after 5 seconds).[1, 2, 5, 6, 7, 8, 9, 10] When making measurements over a wide range of temperature it is best, as temperature increases, to maintain the angle of twist within a suitable range by reducing torque and by using specimens of larger cross-sectional area.[3, 7, 8]

Another method is to find the maximum torque required during the production of a constant angle of twist, such as 90° (in 5 sec.)[3, 7, 12] with constant rate of twist. This may be less convenient experimentally. Results are not exactly equivalent to the constant-torque method and are more difficult to analyse (see Appendix 3).

Cold-flex Temperature

It is easy to obtain cold-flex temperature, originally proposed by Clash and Berg. Specimens are of standard width (0.250 in.) and span (length exposed between grips, 1.500 in.). The measured thickness is used to find, from a table or graph,[1] the angle of twist required to produce the same deformation as 200° twist in a specimen of standard thickness. At each of a few suitable temperatures the angle obtained after 5 seconds under torque of 5.68×10^{-5} dyne-cm. is measured. From a graph of measured angle against temperature, cold-flex temperature is found as the temperature at which the required angle would occur. Effect of thickness, and accuracy of results, are discussed in Appendices 1 and 2.

Cold-flex temperature is useful because it is the temperature down to which the material exceeds a standard of flexibility chosen as being necessary in many applications of flexible compositions. And even when the flexibility required in an application differs from the chosen standard, differences in cold-flex temperature between compositions indicate probable differences in serviceability.

Cold-flex temperature has the useful property of varying linearly with plasticizer concentration up to about 35% in p.v.c. Also, when mixtures of plasticizer are used the effects of the plasticizers are additive.[1, 9]

Deformability or Stiffness as a Function of Temperature

Flexibility over a range of temperature[2, 3, 4, 6] is more informative than cold-flex temperature.

At each temperature, apparent rigidity (shear) modulus can be calculated by substituting in the St. Venant formula given in references quoted. Use of specimens of standard width and span, and constant torque, simplifies computation. Then apparent rigidity modulus is the reciprocal of the product of a factor, which can be tabulated against thickness and the measured angle of twist. The logarithm can be plotted against temperature [7, 8] to give a complete picture of the results.[3, 4, 6] The presentation and use of flexibility results is discussed in Appendix 3.

The New Instruments

Recently Wallace[13] and Baird and Tatlock (B and T)[14] have marketed torsion modulus instruments. These are designed for determination of cold-flex temperature of flexible materials by the method of Clash and Berg.[1, 4, 8] But they could also be used for determination of stiffness at any temperature by provision of a set of pairs of weights increasing by multiples of about two, any pair of which could be hooked on to loops on the end of the tension "strings." Use in this way is subject to the limitation that low

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stiffness would require small weights, even with thick specimens, and accuracy would be limited by variation of friction in the main and pulley bearings. For the purposes of this article, the Wallace instrument is considered.

The Wallace instrument is over 28 in. high, is rather heavy to be easily lifted, and has external wire connections between components.

Manipulation of Bath

The temperature-control bath surrounding the specimens must be lowered to insert and remove specimens. This is facilitated by having the bath counterbalanced, so that it can be raised and lowered by one handle. On the instrument tested, this movement tended to jam, and when sufficient force was applied to start motion, the bath jerked to a rigid stop at the end of its travel. This involved risk of breaking the vacuum flask, and the stirrer motor sometimes hits the upper frame.

Some bath liquids are volatile, inflammable or hygroscopic, and must be stored in a closed container. The liquid cannot be poured from the bath, which must be emptied by suction.

A copper earth wire from the frame to the bath should be added to the instrument, since oil may interfere with electrical contact through the slide.

Specimen Insertion and Removal

The Wallace grips allow fairly easy insertion, but have the disadvantage of requiring a screw-driver for operation.

The span between grips is fixed at 1½ in. and does not permit the small adjustment required by the A.S.T.M.[8]

Temperature Control

The instrument requires cooling, e.g., by solid carbon dioxide, and temperature control is by adjustment of power supply to an electric immersion heater. The control is by rheostat mounted on top of the instrument. This is cumbersome, adds to height, and makes observation of setting difficult for a person of average height when the instrument is on a bench. It has been found more convenient to detach the rheostat and operate it on the bench beside the instrument.

The stirrer is a high-speed impeller in a tube and gives very efficient mixing.

Measurement of Stiffness

The drum has a positive stop which facilitates zero setting. It would be desirable to have a stop-release mechanism to enable angles of more than 335° to be measured. The drum is graduated every 10°, with subdivisions of 1° on a stationary scale, easily read from the front. The diameter of the drum measured was 11.6 cm., in accordance with Clash and Berg.[1] Strong thickness should be allowed for, since, for example, when the drum diameter is increased by two half-thicknesses of string the result is 1% greater.

The brake is controlled by an inverted screw with knurled head, and confusion occurs between directions of rotation for clamping and unclamping. A spring-loaded brake, released by a half-turn of a screw with toggle would be easier to operate and would avoid the possibility of force damaging the drum and bearings.

Resistance to Conditions of Test

Condensation of water and frost occurs on exposed parts due to low temperatures. This caused rusting of clamping screws after only a small amount of use.

Assessment of the Instrument

The instrument would be a valuable asset to any laboratory where performance of flexible materials needs to be assessed by measurement of flexibility over a range of temperature.

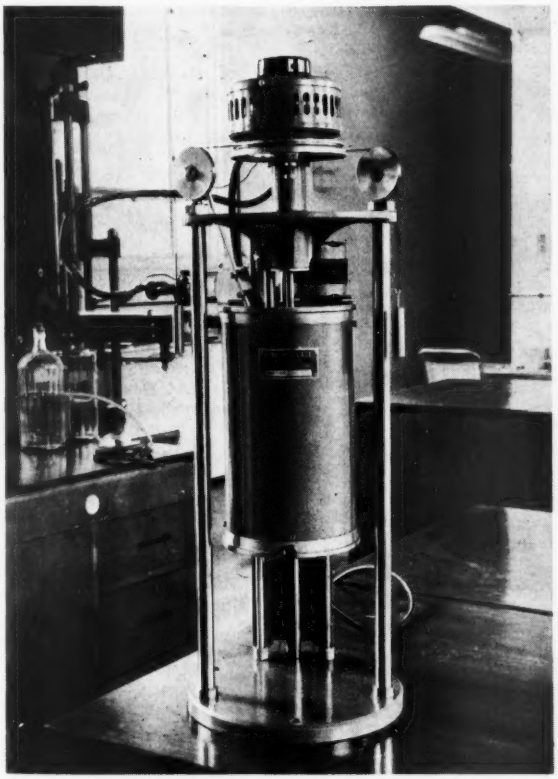
Appendix 1
Effect of Thickness on Cold-flex Temperature

Choice of Standard Thickness

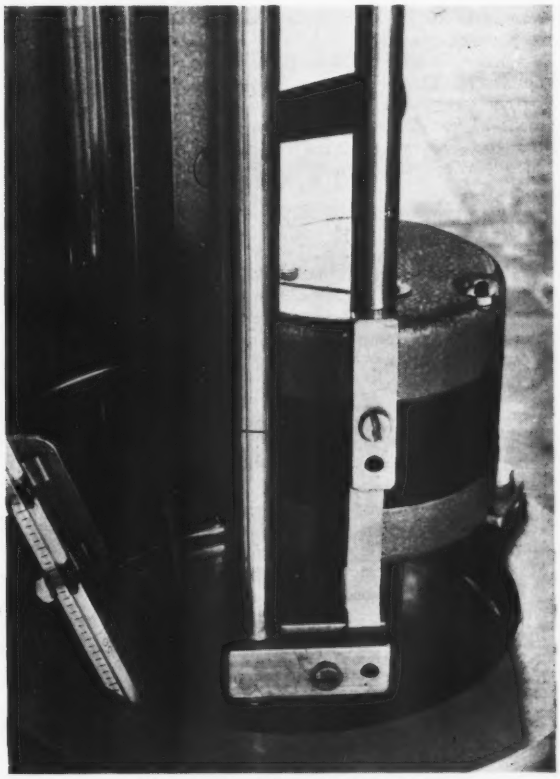
Clash and Berg's cold-flex temperature (T_F), calculated for a standard thickness of 0.040 in., is the temperature at which apparent rigidity modulus is 3.16×10^3 kg./cm.^{2} But Hayes and Lannon[9] use 0.050 in. as standard thickness and consequently measure the temperature at which apparent rigidity modulus is 1.67×10^3 kg./cm.^{2}, which is of order 6° C. higher. Hayes and Lannon's choice is preferable.

Correction for Thickness Deviations from Standard

Cold-flex temperature should not be estimated by applying an empirical correction,[1] depending only on thickness of specimen, to the temperature at which a specimen of non-standard thickness gives 200° twist. Application of this method to plasticized p.v.c. specimens, of thickness 0.038 to 0.050 in.[1], gave errors of standard deviation 1.46° C. This is greater than all other errors of preparation and testing (see Appendix 2).



The Wallace torsion modulus instrument.



Close-up view of bath head and grips.

Appendix 2
Accuracy of Results

The torsion test is sure to increase in popularity. The method is intrinsically capable of considerable accuracy without loss of simplicity. Investigation and elimination of sources of error is, therefore, well worth while, and it is hoped that more studies of errors will be published.

Preparation and Testing Errors

Hayes and Lannon[9] found that, in determining the cold-flex temperature of a plasticized p.v.c. composition, the standard deviation of an individual measurement was 1.32° C., including errors of laboratory weighing, mixing and moulding sheets. If they used t.c.p. as a plasticizer, errors with plasticized p.v.c. would generally be about twice this, because of greater temperature sensitivity of t.c.p. plasticized compositions[3, 4]. For rubbers it is said[7] that standard deviation is of order 1 to 2° C. for replicate measurements, on the same test-piece, of the temperature change producing a given change of apparent modulus.

Accepting the figure of 1.32° C., 95% of individual measurements will fall within ± 2.7° C., of the correct mean. Also an individual measurement on each of two compositions will rank them correctly (with only 5% probability of error) if their correct cold flex temperatures differ by 3.8° C.

Sources of Error of Test

An error of 6% in apparent modulus, equivalent to an error of order 0.5° C., in temperature with plasticized p.v.c., is produced with thin specimens by a thickness measurement error of 2%[1,9] (e.g. 0.001 in., with thickness 0.050 in.). A similar error results from 10% error in timing[5] (0.5 second in 5 seconds).

With specimens of large width to thickness ratio, tension in the specimen causes serious error in apparent modulus[15]. Specimens of nearly square cross-section should therefore be used, and failing this the results should be regarded as only approximate.

Appendix 3
Presentation and Use of Flexibility Results, The Term "Modulus"

Quotation of "rigidity modulus"[7] or even "apparent rigidity modulus"[8] misleadingly implies elastic behaviour, when viscous effects are also important over much of the temperature range.

Deformance

Tests should be made with constant stress rather than constant rate of strain, to facilitate analysis. Then deformability rather than stiffness is measured. Presentation of apparent compliance instead of its reciprocal, apparent modulus, facilitates computation and analysis, and indicates flexibility directly instead of inversely.

Results should therefore be expressed as strain produced by constant stress applied for a specified time, divided by the stress used. It is desirable to have a special term for this quantity when measured in simple shear. The name "deformance" is suggested, in preference to "apparent compliance in shear." A torsion test gives "5-second deformance" (e.g. in sq. cm. per kg.). The definition holds for materials, such as flexible polymers, which show complex behaviour, and the special term avoids suggesting elastic viscous, or any other[5] particular time-dependence of deformation under constant stress. The statement of time indicates that prediction must be restricted to circumstances involving the specified time of stressing.

This method of assessing rubber-like materials expresses flexibility, their characteristic and desirable property, relative to ordinary materials characterized by modulus of rigidity. Loss of deformance of flexible materials at low temperatures represents loss of serviceability, in contrast to apparent modulus for which a high value indicates low quality.

Type of Deformation

Flexibility of rubber-like materials in any type of deformation (at least at low strains) is related to that in shear in the same known way as for ordinary elasticity[4,8]. For example, apparent compliance at low extensions is one third of deformance.

This means that measurements can be made with any convenient type of deformation, e.g., extension, compression, bending (extension and compression), and indentation hardness, as well as shear (e.g. torsion). With plasticized p.v.c., Clash and Berg[4] obtained agreement, after conversion, between results from a bending and a torsion test. British[16] and International hardness degrees for rubber-like materials are related in a completely known way to 30-second deformance[16,17].

Analysis

The ordinary elastic component of deformation is practically independent of temperature, time of stressing and the simultaneous occurrence of other deformation processes. It is obtained by measurement at temperatures low enough for results to be independent of temperature. Subtraction of this value from those at higher temperatures gives the component due to other processes (with the specified time of stressing). This analysis of deformance into ordinary elastic and other components is useful for characterization of the other more complex deformation processes.[6]

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PROPERTIES AND TESTING OF PLASTICS MATERIALS

(*Continued from page 157*)

The Sheen Bend Test Apparatus (26) is used for determining the flexibility of paints and varnishes.

It is suggested that the flexibility of rubber and plastic products (27) depends on the curvature to which they are bent, and a simple test is described. Brief but adequate details are given in the abstract.

The Kauri Reduction Test (28) measures the flexibility or distensibility of coating films (primarily varnishes). A full description of the apparatus is given, with a discussion of its faults and merits. There is a good bibliography.

The Hall Flexing Machine has been developed for testing the cut growth of soling rubbers, and the durability of adhesive joints under flexing. It possesses several advantages over other instruments, especially for testing rubbers of B.S. Hardness 75° and over (29).

The determination of the low-temperature flexibility of synthetic elastomers using the **Dyne Tensiometer** is described (30).

The stiffness, after heating, of vinyl chloride-acetate and vinyl chloride plastics is determined (31) (32).

The ability of standard $\frac{1}{8}$ in. impact specimens of nylon to sustain bending round a $\frac{1}{4}$-in.-dia. mandrel is determined on a **Mandrel Bend Tester** (33).

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Drilling, Machining and Working Plastics

By R. GROVES

THE machining and drilling of plastic materials is not so well understood as it should be, and in the following lines some practical guidance is offered to those encountering these materials for the first time, or those who wish to check their current techniques with modern recommendations.

Taking the drilling of these materials, first, it is essential that the drills used should be designed specially for the purpose. A suitable drill has what is termed a slow helix and a point angle of 30 degrees, the point angle being that included at the point. The object of this is to prevent the plastic from breaking off on the underside as soon as the drill has broken through on penetration. Another beneficial plan is to clamp the material to be drilled on to a piece of wood, if this is practicable; this also greatly assists in overcoming the tendency of the material to break away on penetration.

One of the most difficult factors in drilling plastics is the heavy abrasive wear they throw on the cutting lips and edges of the drill, and this makes it essential to use for these drills a type of steel capable of resisting this type of wear and so giving a long service life not only at the point but also along the flutes. The best steel is one of super-high-speed steel type containing tungsten and cobalt.

The drill itself should have an helix angle of about 15 degrees, together with wide flutes, and it is advisable that the operation should be carried out with no lubricant, using a speed in the region of 300 to 400 ft. a minute. The exact amount of feed must be determined as a result of experiment under actual shop conditions, because there is a wide range of plastic compositions according to the specific purpose, and to quote a single figure for feed might well mislead the operator.

A good deal of heat is inevitably generated by the drilling operations, and it is therefore necessary to remove the drill from the hole as rapidly as possible. In any event it will be found that the eventual hole drilled is somewhat smaller in diameter than the drill, assuming that the drill has been properly ground. The actual difference is about 0.003 in. If it is required to produce a somewhat larger hole, the drill should be ground slightly off centre.

If for any reason the super-high-speed steel drills cannot be used or are not readily obtainable in emergency, it is possible to use drills made from a good high carbon steel, in which case only the holes less than $\frac{3}{16}$ in. in diameter should be drilled dry, a lubricant being used for those above this diameter.

Cutting

For the ordinary machining of the plastic materials with standard cutting tools in the lathe, the most suitable type are the tungsten carbide tipped tools, using a normal grade of carbide. The technique adopted is much the same as for machining metals in the lathe, but no lubricant should be employed and, wherever possible, the plastic should be turned to size in a single cut. In any event the finishing cut should not remove less than $\frac{1}{8}$ in., or it will be difficult to maintain a uniform diameter. The material should be turned at a peripheral speed largely determined by trial and error under actual shop conditions, using 25% higher speed than for cast iron as a basis.

The difficulty with quoting specific recommendations for speeds and feeds is that conditions vary so greatly from shop to shop that what is applicable to one will be totally inapplicable to the other, and an attempt to adopt it may lead to serious trouble. Such variables as age of machine; type of machine; condition; experience and skill of operator; type of carbide tool used; the kind of plastic being machined; all play their part in determining a correct speed and feed, and make it well-nigh impossible for a specific recommendation to be given. What is more to the point is that most toolmakers will usually give advice when told of the conditions prevailing, and some will even send a demonstrator to show how to obtain the best results.

It is usual to employ a tool with a fairly wide nose and a feed on the coarse side. The tool should be given a good degree of clearance, but little or no rake. While a super-high-speed steel may be used successfully, if it is not desired to employ a carbide tool, it is apt to prove expensive if used in the smaller sizes. It is always possible to machine these steels in emergency with a good quality of carbon steel for the purpose, hardened by heating to about 780° C. in water, and instances have been known in which this has proved more successful than, for example, 18% tungsten high-speed steel.

One operation for which tungsten carbide tipped tools have proved most successful is the cutting of plastic rod.

For gear-shaping these materials, it is recommended that 100 to 130 strokes a minute should be used for roughing, employing a fairly fine feed, with tools having from 3 to 5 degrees more rake than for metal. For finishing, it is advisable to try 500 strokes a minute, leaving 0.01 in. on for the finish. Here again, however, the figures given are to be taken merely as a basis for experiment. The rake for milling should be the same as given above, and a high speed with coarse feed should be adopted, so that the cutter will throw the chips away from the work. If practicable, all the material should be removed in one cut without lubricant.

Threading can be carried out with normal taps and dies, using the same lubricant as for metal.

Punching is probably the most difficult operation of all to be carried out on plastics. A plain punch and die can be employed on sheets $\frac{1}{8}$-in. thick, but smooth edges cannot be obtained on material more than $\frac{1}{16}$-in. thick. There should be the least possible clearance between punch and die, and the tools must above all things be kept fully sharp. A little oil may be used on the material and/or grease applied to the punch. Some plastic materials will be punched more readily if subjected to a temperature of about 140° C. on a steam table. Sheets of $\frac{1}{8}$- to $\frac{3}{8}$-in. thickness should first be formed to shape by blanking and afterwards shaved. The work should be heated. Shaving cutters require a rake of about 45 degrees.

Plastic materials thicker than $\frac{1}{8}$ in. should be first sawn out and then finished off by machining in a lathe or miller. Shearing should be done at a temperature within the range 50-150° C. so as to prevent any spalling of the edge.

Sawing

The sawing of plastics is often done by means of a hacksaw, but narrow bandsaws and hollow-ground, solid-tooth circular saws with set teeth are also extensively used. For circular and bandsaws, the same speeds should be used as for hardwoods. The average number of teeth in a bandsaw for plastics is $5\frac{1}{2}$ per inch, and their speed ranges at about 4,000 ft. per min. Circular saws for plastics operate mostly at about 6,000 ft. a minute. The steel of which both types of saws are made should not be so hard that a file will not touch it. It will be necessary to sharpen and re-set the saws frequently. We will take bandsaws first. These are of narrow type, and the gauge of the saw should always be selected to conform to the diameter of the wheel. Thus, for a 12-in. wheel, a 26-gauge saw will be required, and for a 42-in. wheel, a 20-gauge saw. Failure to cut properly may often be the result of cracks forming in the gullets of the teeth, stretching of the saw, failure of the saw to keep the line, fracture of teeth, or fracture at the braze. The saws are usually tensioned for a peripheral speed of 10,000 ft. a minute. The causes of these failures are various, and the operator should check the undermentioned points.

First, check that the gauge is correct for the wheel size, since if the saw is too thick it will cause gullet cracks. Then examine the rubber bands, and ensure that any that are unduly worn are replaced, as otherwise there will be strains thrown upon the saw. If too much set has been given to the teeth, the blade will become distorted, and the set should be regulated. The teeth should be kept sharp, using a suitable taper saw file. If cracks appear in the saw teeth, they should at once be brazed. Badly formed teeth should be re-set and corrected by filing so as to make the face of every tooth radial, without hook or rake.

If the saw has stretched, it is because there is too much pressure against the back guide, which should therefore be adjusted until the back edge of the saw just touches and no more when the plastic is fed to the saw.

A saw running out of line is either too thin, too narrow for the plastic being cut, or not properly strained on the wheels. The strain should be corrected according to the tables supplied, and the saw replaced for one of the correct thickness and width. Sometimes improper guide adjustment is responsible for this fault, in which case the upper guide should be located so as to clear the work by a small amount only, with the bottom guide as near as possible to the bottom of the saw table. The guide pins on each guide are then positioned so that they just clear the saw sides behind the set line.

Brazing

Fracture at the braze is caused by bad workmanship in brazing, the brazed portion being different in thickness from the rest of the saw, causing either weakness at the joint, if too thin, or hanging up in the guides, if too thick. After rebrazing, warm the saw to prevent loss of efficiency through brittleness.

Circular saws when used on plastics may fail because of cracks in the tooth gullets, overheating of the saw, or leading in the cut. The causes of these failures include improper tension in relation to speed, hardening of the gullets, blunt teeth, improper lead or rake of teeth, wrong thickness and teeth, inadequate clearance, or a saw not strong enough for its work.

Steps that may be taken to remedy these faults are as follow. For cracked gullets, check the mandrel speed and, if necessary, provide a saw having correct tension. When grinding the gullets of the teeth, use a soft wheel and a light cut. The form of the teeth should suit the type of plastic. Some need a positive, some a negative, rake (slight only). Some need teeth with a radial face. Thin saws with fine teeth are required for the thinner sheets, and thicker saws with coarse teeth for the thicker work.

It should be noted that as a saw becomes worn, its diameter is reduced, and this results in a reduction of side clearance, so that as soon as an appreciable reduction in diameter has occurred, the saw should be taken out and reground with the proper clearance, while the teeth should be resharpened, without bevel either on face or back. If the plastic material to be sawn is one of the softer qualities, the face of the teeth may be bevelled alternately with the back, but all teeth must be identical in height.

Thin saws require slow feed. For thick, hard plastics use a saw of somewhat greater thickness.

Tapping

Another operation often applied to laminated plastics is tapping. This, like drilling, throws a good deal of abrasive wear on the taps owing to the contraction of the holes and the seizing of the tap as it is withdrawn. High-speed steel taps are best, and should tap from 600 to 800 holes. If ground thread taps of high-speed steel are employed, the output will rise to 1,000-1,200 holes. Such tools are sometimes said to give longer life and better performance if chromium plated, and it is then claimed that they can be taken out, resharpened and freshly plated from nine to twelve times. The amount of thread relief given should exceed that used in tapping metals. Jets of compressed air are considered the most suitable form of " lubricant," so-called. Tapping speeds depend on the diameter of the tap and on the type of plastic, but as a basis for experiment, the range is from 3,500 to 647 r.p.m. (54-40 surface speed in ft. per min.) for taps ranging from 0.069 to 0.2362 in. diameter.

MECHANICAL APPLICATIONS OF POLYESTER RESINS

(*Continued from page* 148)

mixing, a formulation was chosen which on hand mixing and subsequent moulding, yielded a test piece with an impact strength of about 23 ft./lb. A part of this mix was then treated in an unamended Baker Perkins-type mixer and after about 10 minutes' mixing the moulded test piece gave an impact strength of less than 1 ft./lb. It is thought that this is due to breakdown of the glass fibres; not, however, to a simple length decrease, but a defilamentization or delamination of the fibres themselves.

The main influence on the strength characteristics of the moulded part is the fibrous glass, and it may be of interest to mention that a series of experiments have been carried out to investigate the effect on physical properties by varying: (a) The fibrous glass content. (b) The fibre length. (c) The mixing times.

The experiments were carried out in a modified Baker Perkins-type mixer. This mixer is a double-bladed sigma mixer, each blade revolving in a separate trough, and one blade turning at a different speed from the other. It is necessary to modify the standard mixer in such a way as to have a large clearance between the blade and trough, and blade and blade, and also the blades themselves need to be serrated. In the experiments where the mixing time was not a variant, the time was standard and was of five minutes' duration.

The first series of experiments was to determine the effect of glass content, and mixes were made containing 30, 25, 20, 15 and 10% of $\frac{3}{8}$-in. glass fibres. It should be mentioned at this stage that all the glass fibres used in the whole series of experiments were of electrical-grade glass, Volan treated. Test specimens were moulded from these mixes for tensile, impact and crossbreak values. The impact, tensile and water-absorption figures decreased with decreasing glass content. Maximum figures obtained were:

Impact, 9.9 ft./lb. Izod.
Tensile, 9,000 lb. per sq. in. (see Graph I).
Crossbreak, 12,000 lb. per sq. in.

It is of interest to report that to obtain a good surface finish it was necessary to lower the glass content such that the impact and tensile strengths were about half of the maximum values obtained.

The second series of experiments was to determine the effect of glass-fibre length on physical properties. The glass content of each of these mixes was 20% by weight. Physical tests showed that the impact, tensile, crossbreak and water-absorption figures decreased with decrease in fibre length. The best surface finish and flowability of this series were obtained using the shorter fibre length (see Graph II).

The third series of experiments was to determine the effect of mixing time on impact strength. It was known that too long a mixing time resulted in low physical strengths due to damage of the glass fibres. A mix was made containing 32% by weight $\frac{3}{8}$-in. glass fibres and samples were removed after various mixing times. The impact strength of these samples showed that a figure of 5.1 ft./lb., obtained after five minutes' mixing, dropped to 1 ft./lb. after a further 10 minutes' mixing. The flowability and surface finish improved with increase in mixing time. Optimum physical properties are thus obtained using the shortest mixing time possible (see Graph III).

Another interesting line of approach is to examine the effect of different types of inert fillers. Some experiments were carried out using an extremely hard inert filler of the Cornish-stone type, and disappointingly low impact resistances were obtained.

These experiments lead to the conclusion that high-strength doughs can be obtained having impact strengths of 7 ft./lb. upwards, but at least 30% by weight of glass is required to obtain these figures. These doughs are somewhat difficult to mould and give a poor surface finish. The mouldability and surface finish can be improved by two methods, each of which involves some decrease in physical strength. These methods are: (a) Decrease in glass content. (b) Decrease in fibre length, but not glass content.

It would appear that a good general-purpose dough could be obtained by using 20% by weight of $\frac{1}{2}$-in. glass fibre. This should give:

An impact of about 4 ft./lb.
A tensile of 4-5,000 lb. per sq. in.
A crossbreak of 12-13,000 lb. per sq. in.

It will be observed from the foregoing that, owing to the physical nature of these doughs, the catalyst has to be included during the mixing process. Since these compounds are necessarily hot-moulded, the catalyst chosen will have a relatively high activation temperature. This means there is some stability at room temperatures, but the storage life is not very long and largely depends on ambient temperature.

It should not be forgotten that these doughs give relatively cheap mouldings of a high order of impact resistance.

Pressing.—As with preforming, low-pressure compression presses are required and the cure cycle with doughs is of a similar order as described under preforming. Temperatures in the range 120°-125° C. are usual, but the question of pressure is somewhat controversial. It is thought that somewhat high pressures are needed, say, about 800 lb. per sq. in. Even higher pressures have been used leading to better surface finish.

PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. The country of origin for Convention Applications is shown in parentheses. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 2s. 8d. each (including postage).

B.P. 723,967. Luminous signs. C. K. Shaw.

The moulded lettering is given an insulating coat of chemically neutral material as a foundation for luminescent pigments applied in successive layers. The sections where luminescence is not required are overpainted in black.

B.P. 723,981. Hearing aids. M. H. Hollingsworth (U.S.A.).

Hearing aid device (microphone, etc.) combined with a spectacle frame.

B.P. 724,008. Knob and shaft assemblies. J. Strange. To: Simmonds Aerocessories, Ltd.

The hexagonal recess of the knob fits over the hexagonal head of the shaft. A spring-urged pin in the head is caught in a hole in the knob preventing its removal.

B.P. 724,098. Method off, and apparatus for, effecting transverse seals in thermo-plastic tube or multiple ply ribbon sections. To: Milprint Inc. (U.S.A.).

The flat tube or ribbon sections are advanced in succession along an arcuate path. The end portion of each section is subjected transversely to a simultaneously advancing heat while pressure is applied to the other ply.

B.P. 724,103. Injection moulding apparatus. Plastic Products, Ltd., D. L. Wenham.

In the usual cycle of operations, the press opens and closes twice a minute. To prevent foreign matter remaining between the mould parts causing damage, two co-acting control parts are built in, so that a predetermined pressure cannot be exceeded if the distance between the mould parts is more than a set distance, i.e. if more material is in the mould than only the injected plastic.

B.P. 724,104. Process for making articles to fit parts of the human body. Amplivox, Ltd., J. P. Ashton.

The process concerns the manufacture of dentures and of hearing aids. The use of wax or alginate impression material has the disadvantage of too rapid setting (wax) or of shrinking (alginate), so that the casts are not correct. Ethyl methacrylate polymer powder made into a dough-like paste with a suitable liquid is suggested.

B.P. 724,136. Moulding sand-synthetic resin compositions. To: Borden Co. (U.S.A.).

A hydrophillic thermosetting urea or phenolic resinous binder is used.

B.P. 724,187/188. Polymerizable compositions. To: British Thomson-Houston Co., Ltd. (U.S.A.).

"Anaerobic monomers" remain non-polymerizable at around 80° C. or less as long as oxygen is passed through them. Polymerization of the oxygenated compound proceeds rapidly if oxygen is excluded.

B.P. 724,204. Coating compositions. To: Wingfoot Corp. (U.S.A.).

Erosion resistant coatings for radar housings on aircraft and guided missiles are obtained from air-curing neoprene compositions.

B.P. 724,216. Process for the production of pigmented rolled masses for use in lacquers. To: Deutsche Gold- und Silber-Scheideanstalt vorm. Roessler (Germany).

B.P. 724,236. Process for the production of thermosetting polyamides. To: Farbenfabriken Bayer (Germany).

By condensing certain ammonium salts in the presence of water.

B.P. 724,265. Shuttlecock and method of manufacture thereof. C. J. W. Lashley.

Characterized by a skirt with two sets of curved vanes intersecting each other and forming a lattice structure. Skirt and base as a one-piece moulding (nylon).

B.P. 724,267. Process for producing a closed-cell cellular thermoplastic resin article. To: Lonza Elektrizitätswerke and Chemische Fabriken A.G. (Switzerland).

"Wrinkled" cell walls highly resistant to breaking are obtained by reducing the gas pressure in gas expanded closed cells to below atmospheric pressure and by allowing atmospheric pressure partially to collapse those cells. Suitable for shoe soles.

B.P. 724,274. Method and apparatus for coating a flexible web. P. J. Massey (U.S.A.).

Preparing supported films of high melting point thermoplastic material (vinyl resins, polystyrene resins, polyethylene and the like).

B.P. 724,364. Stoppers for containers. M. J. Ibbetson, H. Ibbetson.

With a depending spigot portion in the opening and an outer (shorter) skirt around the opening.

B.P. 724,370. Pocket sprayers. I. Hussein, P. Florjancic (Switzerland).

B.P. 724,379/380. Method for making a predetermined metallic pattern on an insulating base. To: General Electric Co. (U.S.A.).

The base for the "printed circuit" may be a phenolic plastic.

B.P. 724,393. Collar studs. J. Spink.

B.P. 724,398. Support-bandage. G. V. I. Hultgren (Sweden).

A number of elements with stamped-out holes connected by narrow bridges. Hard polyvinyl chloride, cellulose acetate, cellulose nitrate or similar materials are suitable.

B.P. 724,402. Process for exposing the non-metallic protecting layer of a metal container. To: Stahl- und Walzwerke Rasselstein/Andernach A.G. (Germany).

For removing the lacquer film of a preserve cover by completely dissolving by electrolysis the metal wall at the place to be exposed (for testing or for making a transparent window to show the contents).

B.P. 724,465. Method and apparatus for solvent sealing regenerated cellulosic sheets. To: American Viscose Corp. (U.S.A.).

The sheet areas to be sealed are treated with an aqueous solution of an alkali metal hydroxide at a temperature below freezing point, then subjected to pressure.

B.P. 724,494. Document covers. W. Lennartz (Germany).

Two plastic sheets hinged together with insertion pockets inside the free corners.

B.P. 724,558. Process for the production of vinyl chloride polymers. Solvic S.A. (Belgium).

B.P. 724,585. Tamper-proof container closures. J. W. Soffer. To: Development Research Inc.

A closure of a brittle vinyl plastic with a portion of the closure skirt grasping the container lip. This portion (tooth) must be broken out to remove the closure.

B.P. 724,595. Elements for photolithography. G. F. Nadeau, C. B. Starck. To: Kodak, Ltd. (U.S.A.).

A metal foil with three layers, a specified vinyl chloride copolymer, a composition containing a cellulose organic acid ester, and an overcoat of a composition containing cellulose acetate-butyrate and an antihalation dye (the outer stratum hydrolyzed).

B.P. 724,648. Device for controlling the flex of an electric iron when in use. S. F. Sparrow.

A spring armlet with hooks. Plastic-covered wire is used.

B.P. 724,671. Disposable syringes. To: J. Bishop and Co., Platinum Works (U.S.A.).

With a number of plastic parts.

B.P. 724,673. Shuttlecock. K. A. S. Widegran.

A single piece injection moulded body having a cupola-shaped front portion and a slotted truncated hollow cone.

B.P. 724,694. Closure for containers. B. Witwer, E. Müller-Wittwer, H. Wittwer (Hs. Wittwer and Co.), M. Risler (Switzerland).

A tube closure pivotally mounted on the tube.

B.P. 724,696. Painting shields. I. P. George.

Made of polystyrene (add. B.P. 695,572).

B.P. 724,704. Filters for cigarettes, cigars or cheroots. L. Jänecke (Germany).

Absorbent cotton between two discs of viscose sponge.

B.P. 724,739. Apparatus for radio-frequency electric welding of plastic materials. To: Ateliers de Constructions Electriques de Charleroi (France).

Two rectangular plates with rounded and protruding edges are arranged in the same plane on a common support at a distance from each other about equal the length of each electrode. The sheets to be welded are placed on a rubber sheet over a metal plate.

B.P. 724,753/758. Composite metal-fibrous structures. E. P. King. (add B.P. 635,823).

At least one of the metallic layers is ribbed. A synthetic resin bond is used.

B.P. 724,759. Preparation of films and filaments. E. I. Du Pont de Nemours and Co. (U.S.A.).

For direct formation of condensation superpolymer films and filaments.

B.P. 724,782. Sand-resin moulds and cores for casting metals. A. L. Boegehold. To: General Motors Corp. (U.S.A.).

B.P. 724,786. Method for improving and preserving the properties of artificial sponges. A. Cattaneo. To: M.A.P.L.A.s.r.l.

The sponge material cut into suitable pieces for use is subjected to an aqueous solution of a hydrophillic substance, then treated to remove excess of solution, finally sealed in a water impervious container (film of chlorinated rubber).

B.P. 724,798. Self-closing collapsible tube. T. F. Schlicksupp.

A closure member integral with diaphragm attached is used.

B.P. 724,800. Fish plate for rail joints. To: Riv-Officine di Villar Perosa S.p.A. (Italy).

Consisting of a plurality of laminated resin-impregnated sheets sealed under heat and pressure.

B.P. 724,878. Pocket chess sets. A. J. Warhurst.

The surface of the board is made of a transparent plastic the pattern being applied to a back sheet.

B.P. 724,918. Method for the manufacture of bags and sachets. To: Cellophane Investment Co., Ltd. (France).

A rip-cord is incorporated in the strip of bag material which is folded over the rip-cord and hot-pressed at intervals to produce welds. The strip and cord are then cut to form bags.

B.P. 724,987. Bookbinding made of thermoplastic sheets, welded in a high-frequency field. To: Körting Radio Werke Oswald Ritter G.m.b.H. (Germany).

Multi-layer soft polyvinyl chloride sheets with an outer layer extending over the whole binding are strengthened in the cover portions by plates of hard thermoplastic sheet material welded along their edges.

B.P. 725,025. Closure member for a syringe. To: Eli Lilly and Co. (U.S.A.).

Of a semi-pliant synthetic resin with an annular recess and a plug fitting into the bore of the nozzle of the barrel also made of a semi-pliant synthetic resin.

B.P. 725,040. Electric heating of rotating rollers. G. Ardichvili (France).

For use in the production of strips or sheets, e.g., of plastic material. Uniform heating is obtained by auxiliary heaters at one or both ends of the roller to compensate for the temperature drop.

B.P. 725,041. Dropper closure device for dispensing liquids in drops. I. Martinelli (Italy).

Composed of a hollow outer (plug) part and an inner (dropping) part with a liquid guide channel.

B.P. 725,076. Separator for electric storage batteries. To: Robert Bosch G.m.b.H. (Germany).

A perforated corrugated sheet of polyvinyl chloride ("Igelite") and a sheet of porous impregnated paper.

B.P. 725,077. Closures or stoppers for bottles or containers. H. Kuester, Ernst Kuester Kolibriwerk (Germany).

Polyethylene as sealing element elastically slipped over the rim of the hollow cylindrical stopper.

B.P. 725,084. Cinematograph projection screens. G. R. Brakell.

A large-width screen made up of a plurality of smaller-width sheets composed of a thick base sheet and a thin layer which overlap. The base sheets, e.g., of polyvinyl chloride, are joined by high-frequency welding together with the overlapping portions of the thin layer which also may be of polyvinyl chloride carrying a light-reflecting paint.

B.P. 725,100. Hollow moulded plastic articles and method of forming same. To: United States Rubber Co. (U.S.A.).

Refers to waterproof footwear (or gloves, gaiters, etc.), having a warm cellular lining. A heated hollow metal mould is used, in which a creamy resinous material (a vinyl plastisol) is slush moulded. Excess is removed, the deposit gelled and the mould refilled with a similar material containing a blowing agent. Further operations for fusing and bonding produce a seamless article with a tough outer wall and a thermal insulating inner lining.

B.P. 725,112. Single-piece closure for bottles and the like. G. Wieckmann, H. Hufnagel (Germany).

The elastic stopper has a number of concentric thin cylinders of increasing diameters connected by solid webs, which are displaced angularly. For contents under pressure, an eccentric arrangement of the stopper is preferable.

B.P. 725,115. Printed circuits. To: Erie Resistor Corp. (U.S.A.).

Foil is embossed under pressure into an uncured plastic impregnated sheet of insulating fibres. After curing, the consolidated sheet is abraded to cut away the unembossed parts of the foil.

B.P. 725,167. Caps or covers for sealing containers. M. Nesme.

The plastic seal may be composed of one part (by weight) of a polyvinyl halide and 1.5 parts of a phthalate as plasticizer.

B.P. 725,170. Fastener devices. To: United Carr Fastener Corp. (U.S.A.).

A snap fastener of a single piece of moulded synthetic resin forming part of a buckle.

B.P. 725,192. Method of manufacture of a flexible tubular container of thermoplastic material and machine for carrying out the said method. To: Regoma Co., Ltd. (Switzerland).

The part of the tubular blank which, in the finished article, will be adjacent to the head, is kept at a temperature below that at which the thermoplastic material softens.

B.P. 725,278. Packaging process for food and package produced thereby. L. Peters.

A reversible film pocket formed by a thermoplastic film over the moulded soft plastic food, to which a thermoplastic cover is secured by heat-sealing. A tab on the cover facilitates removal.

B.P. 725,289. Plastic compositions. To: United States Rubber Co. (U.S.A.).

A material of high impact strength is made from a mixture of polystyrene (30 to 65%), a resinous copolymer of styrene (80-95%) and butadiene, and a rubbery copolymer of butadiene and styrene.

B.P. 725,359. Method producing bipolar accumulator plates. W. G. Schmidt.

The edges of the lead sheet are embedded in a surrounding frame of insulating material by die casting. The insulating (thermoplastic) material may have been injected into the mould in liquid condition.

B.P. 725,404. Mixtures of gum plastics and polyvinyl acetal resins. To: United States Rubber Co. (U.S.A.).

B.P. 725,405. Mixtures of polyvinyl acetal resins with ethyl acrylate polymers. To: United States Rubber Co. (U.S.A.).

B.P. 725,406. Mixtures of polyvinyl acetal resins with rubbery chlorosulphonated polythene. To: United States Rubber Co. (U.S.A.).

B.P. 725,407. Mixtures of polyvinyl acetal resins with chloroprene synthetic rubber. To: United States Rubber Co. (U.S.A.).

B.P. 725,420. Playing-cards container. W. Cameron. To: Rotopic, Ltd.

B.P. 725,436. Apparatus and method for producing embossed thermoplastic film and the like and the product thereof. M. A. Chavannes (U.S.A.).

The embossing roller is perforated or porous. Suction draws the hot, soft film against, and down into, the embossing surface of the roller.

B.P. 725,456. Production of shell moulds for casting. To: General Motors Corp. (U.S.A.).

Refers to the provision of thin-walled sand-resin moulds which give off substantially reduced amounts of volatile constituents on contact with the molten metal.

B.P. 725,462. Apparatus for forming shell moulds. To: Walworth Co. (U.S.A.).

B.P. 725,468. Thermoplastic copolymer. To: Rohm and Haas Co. (U.S.A.).

Surface coatings containing (a) glycidyl acrylate or methacrylate, (b) a tertiary-butyl or amyl ester of acrylic or metacrylate acid. (c) a certain ester containing an alkyl group. are applied as a liquid, heated and converted to the thermoset stage.

B.P. 725,470. Shell moulding. To: Ford Motor Co., Ltd. (U.S.A.).

B.P. 725,472. Micro-groove disc record or band. To: Dynamit A.G. vorm. Alfred Nobel and Co. (Germany).

Polyvinyl chloride (or copolymer) is plasticized with tar pitch.

B.P. 725,536. Shoestring knot retainer. A. Cataldi.

B.P. 725,652. Industrial stacking tray. G. H. Bowler. To: British Moulded Plastics, Ltd.

Side walls and base with means for interlocking with like trays alongside and with the top edge of a rear wall of a tray underneath.

B.P. 725,705. Foils and coatings from pastes of vinyl chloride polymers and plasticizers. To: Badische Anilin- and Soda-Fabrik (I.G. Farbenindustrie A.G.) (Germany).

Foils and coatings having a mat, dry surface with a dry, leather-like handle are obtained by adding to the pastes, before they are processed, aqueous emulsions of paraffin waxes.

B.P. 725,707. Cross-bottom bags. C. Honsel (Maschinenbau Honsel and Co.) (Germany).

Particularly in the manufacture of bags with tabs from transparent foil, the tab becomes torn at its root when making the bottom, and the finished bag is then not tight. Resistance to tearing is obtained by providing circular or line impressions at the end of the longitudinal edges of the tab.

B.P. 725,860. Stoppers for bottles, flagons and similar containers. H. C. Larrieu, J. L. Laffitte.

A head and a hollow body portion (cylindro-conical skirt) of thermoplastic material with differently spaced stepwise-arranged annular ribs right down to the lower beaded edge of the skirt. The thickness of the skirt is preferably between 0.1 and 0.5 mm. Polythene, "alkathene," nylon are particularly mentioned.

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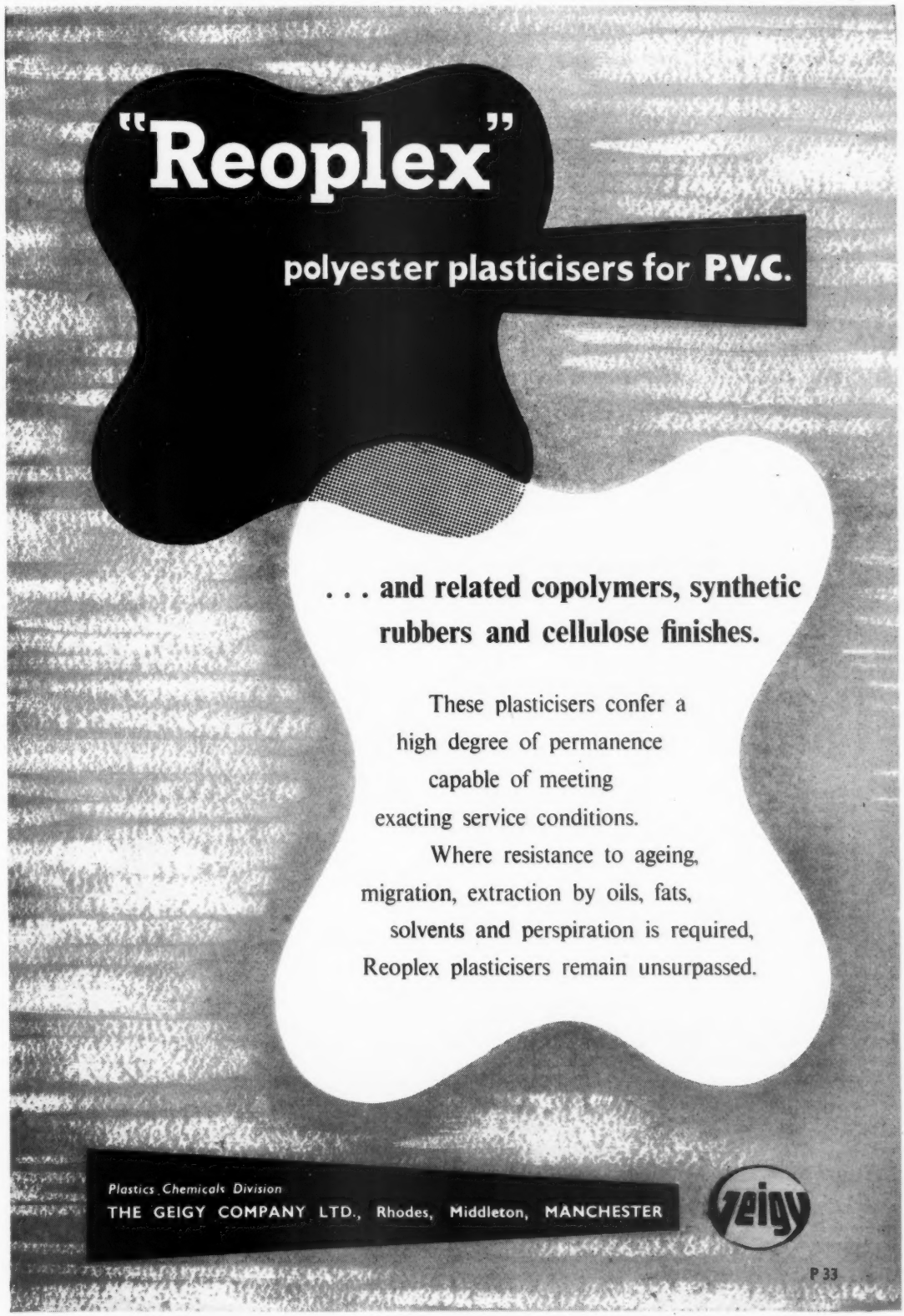
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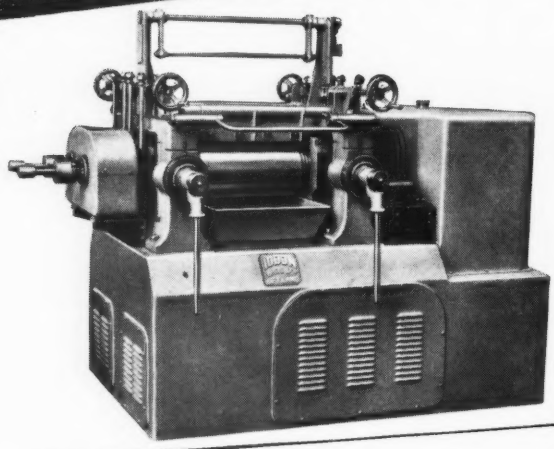

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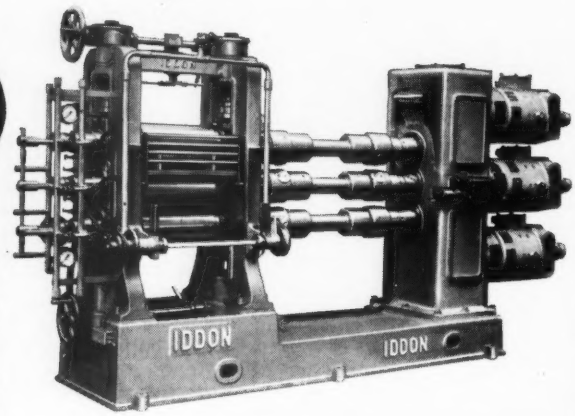

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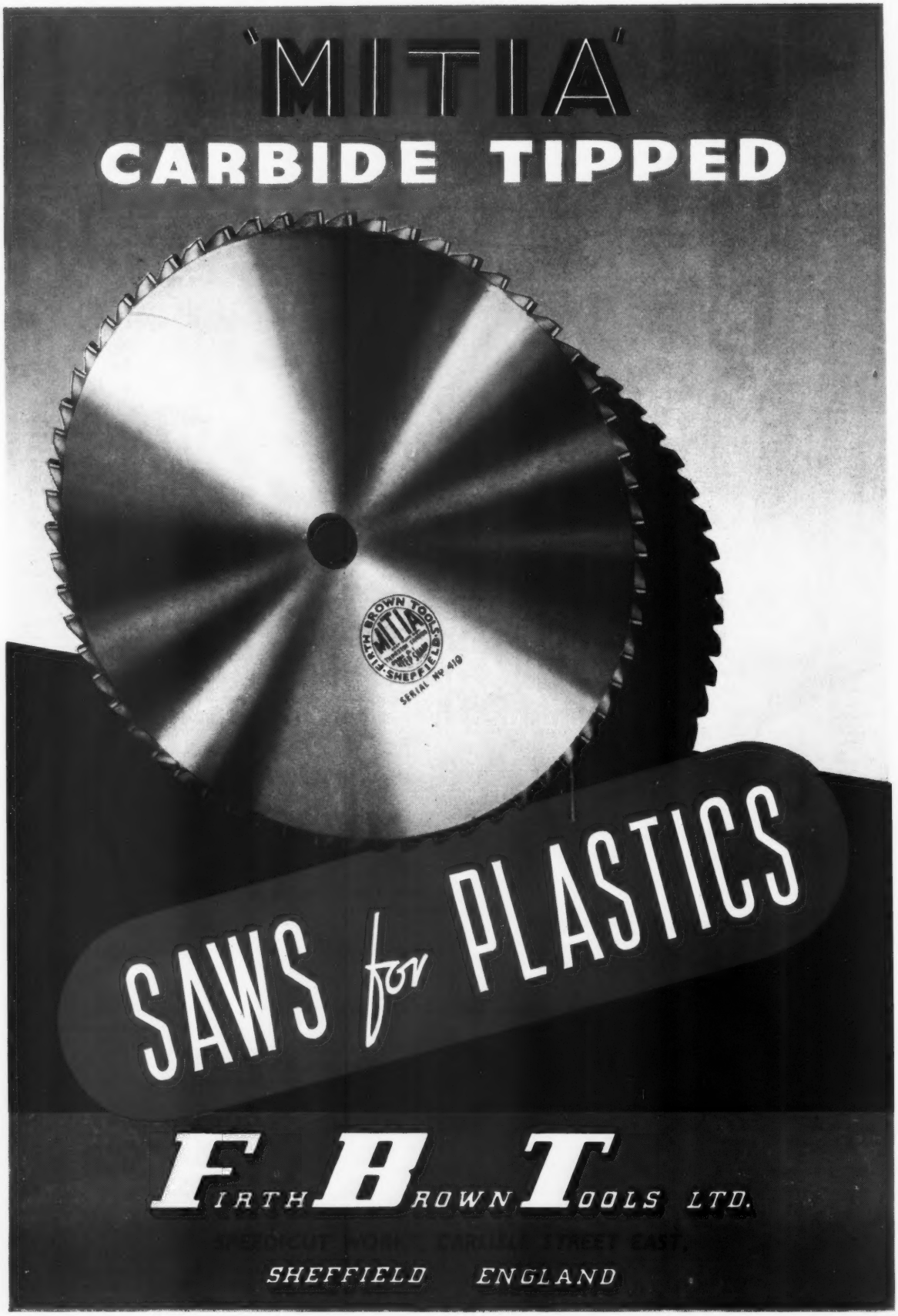
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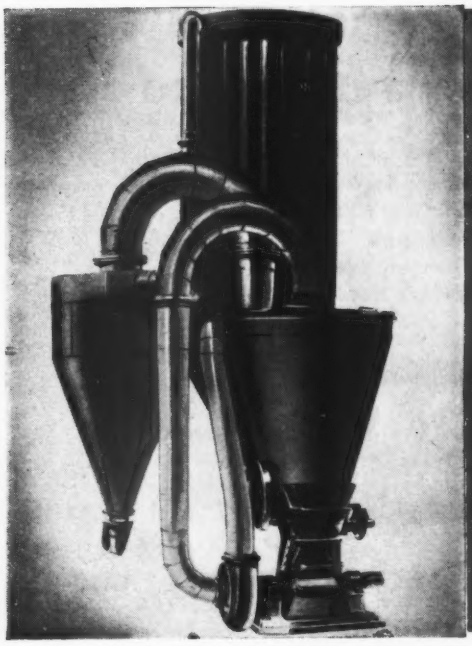

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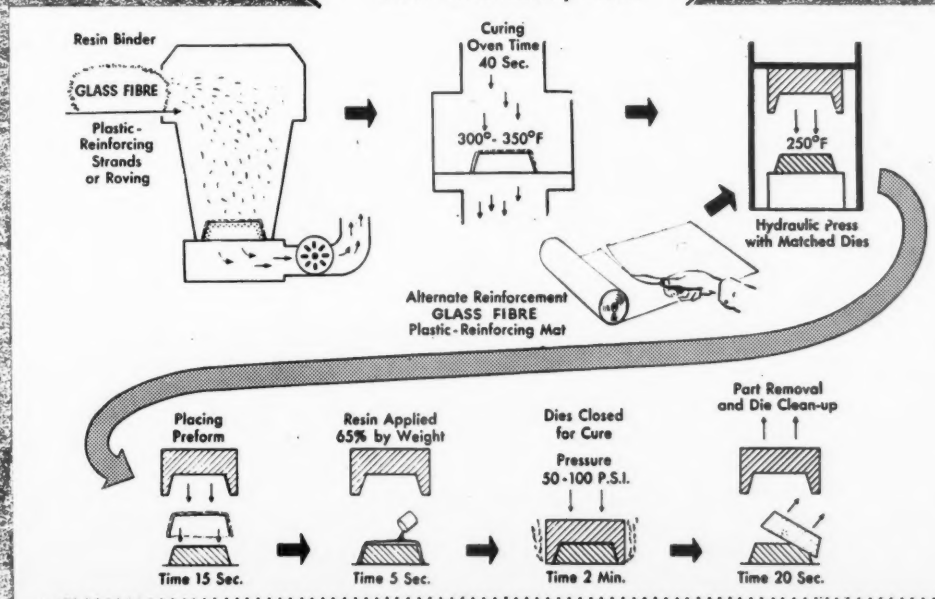
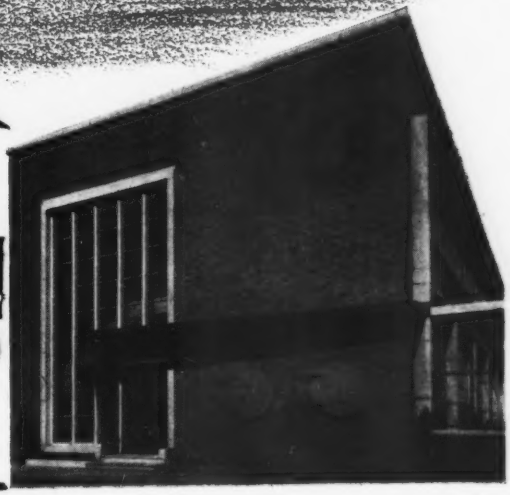


FOR FURTHER PARTICULARS PLEASE WRITE TO OUR TECHNICAL SERVICE LABORATORIES



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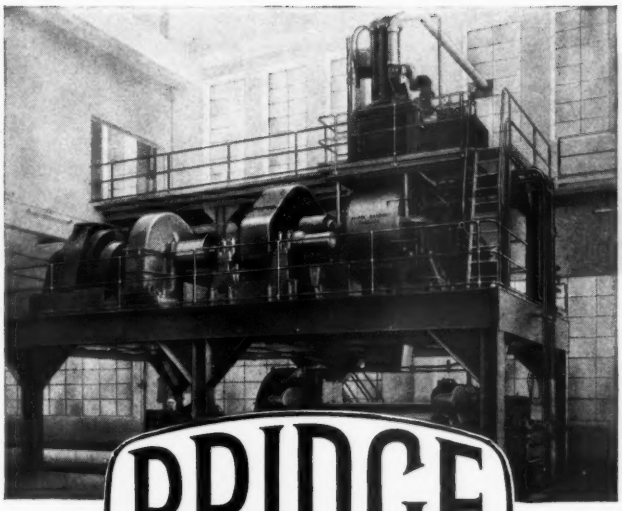

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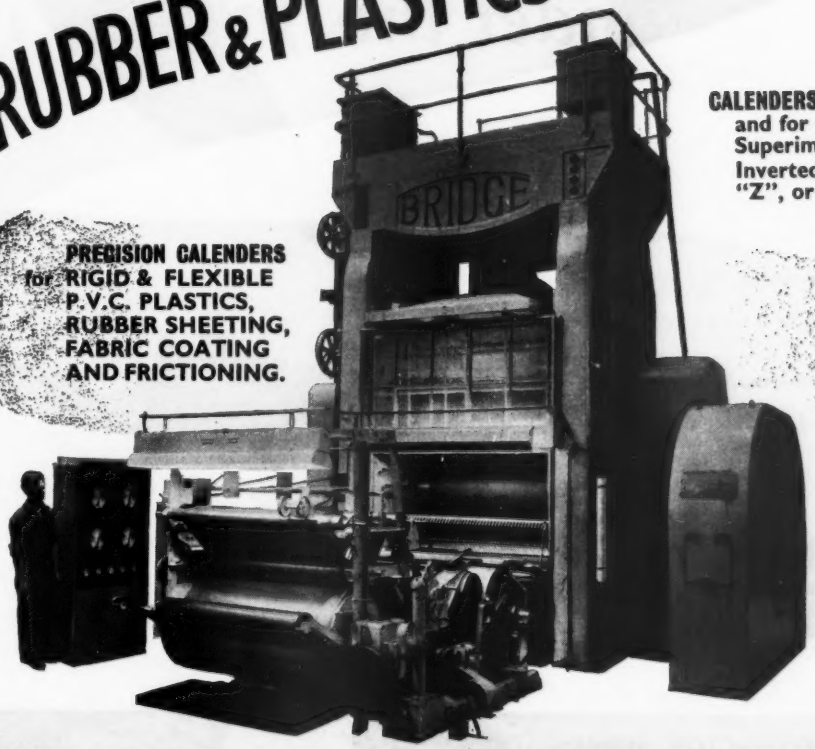

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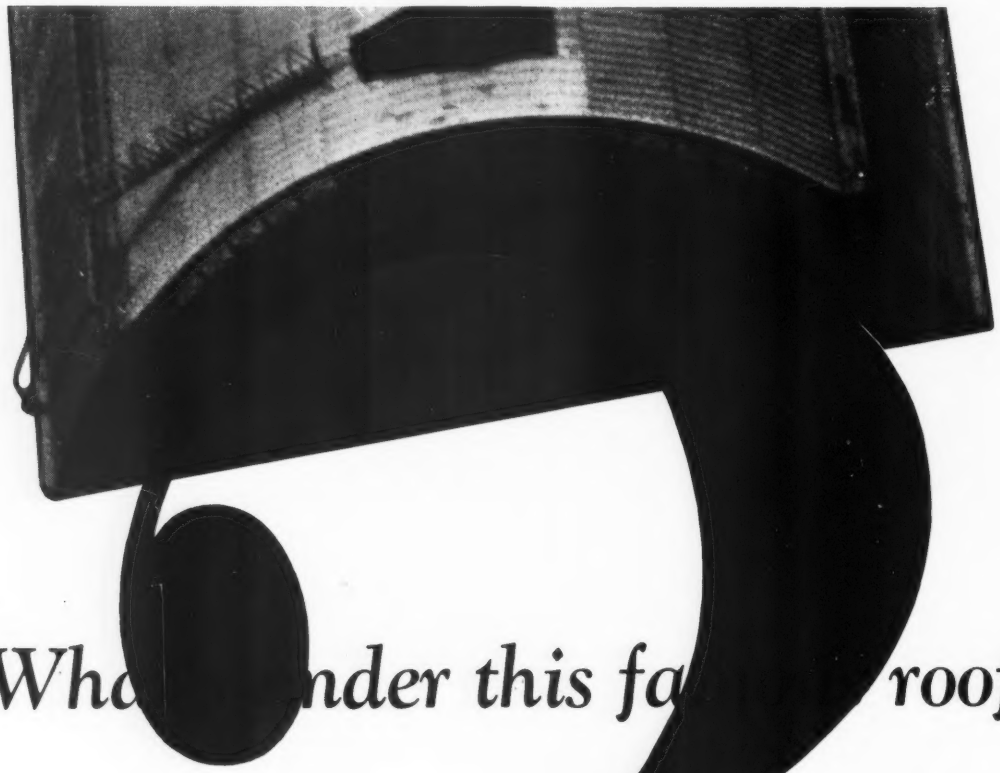

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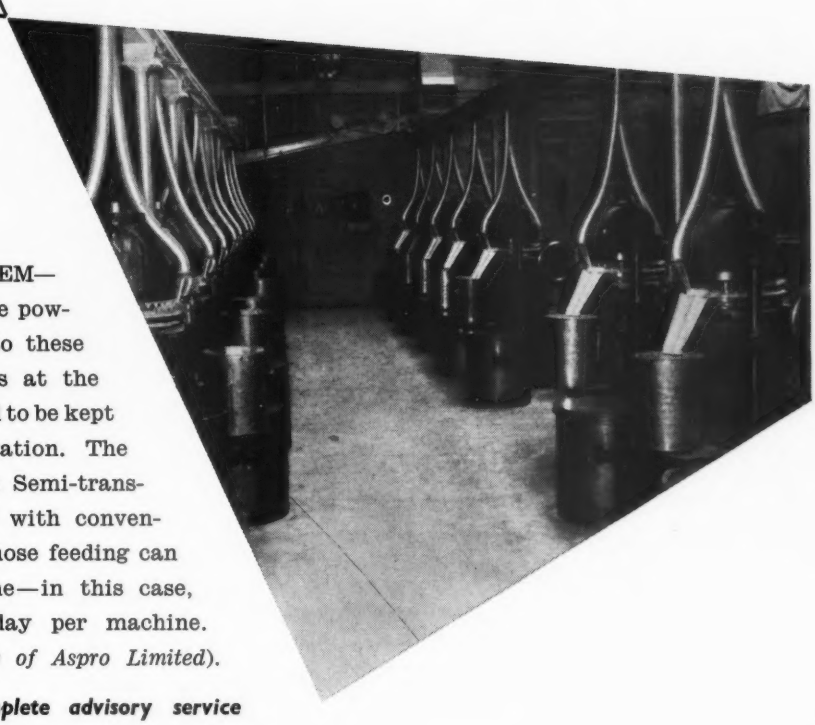

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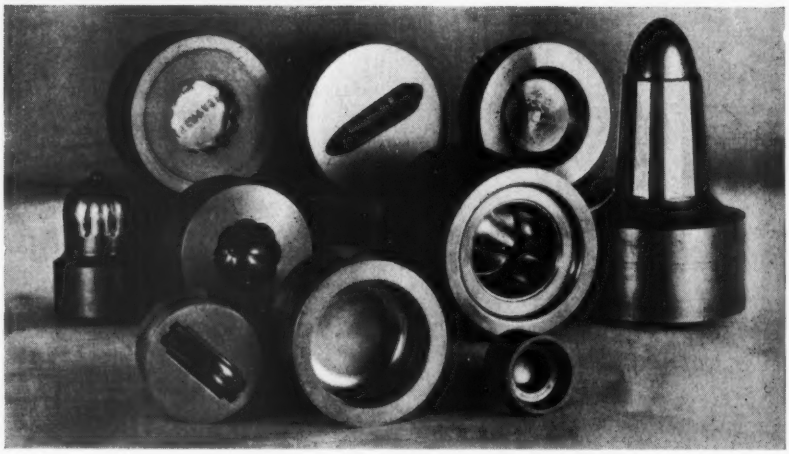

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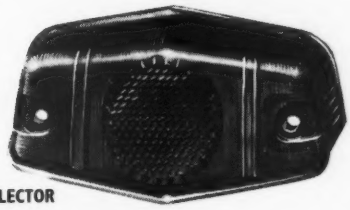

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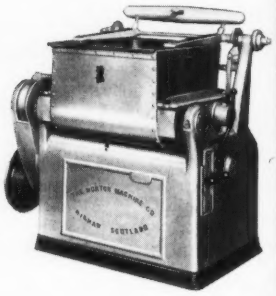

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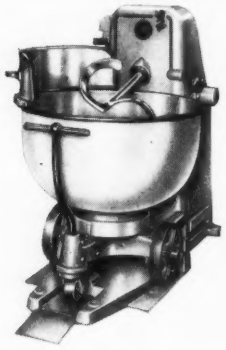

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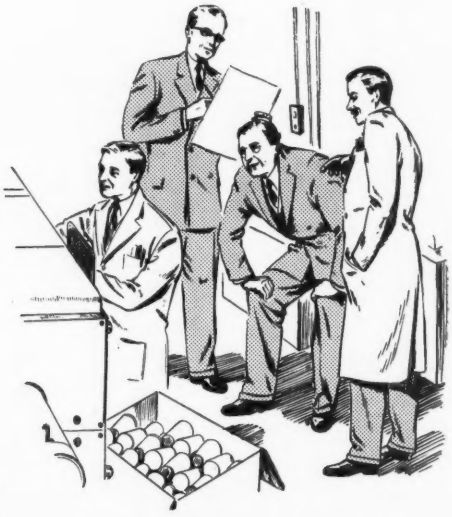

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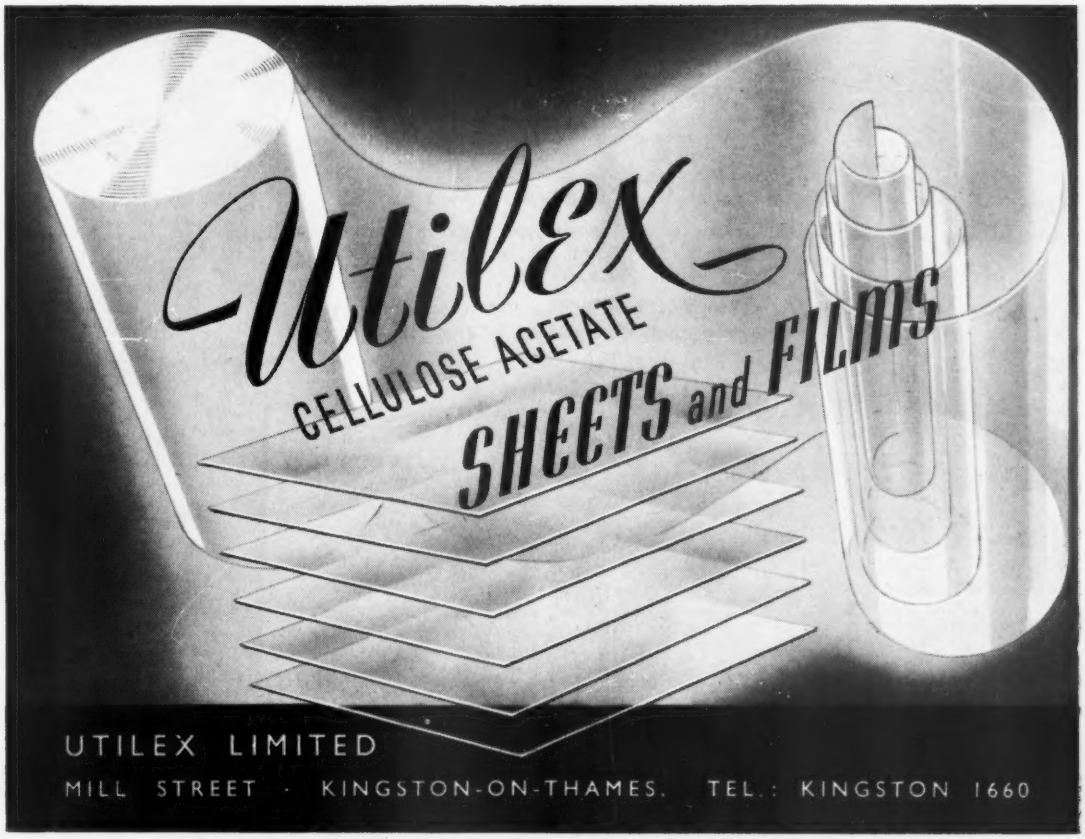

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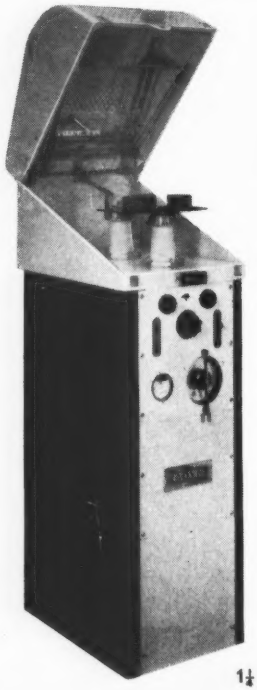

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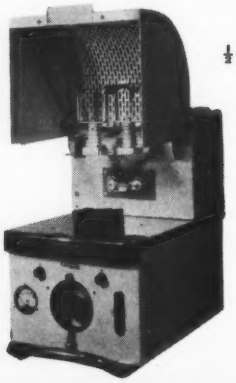

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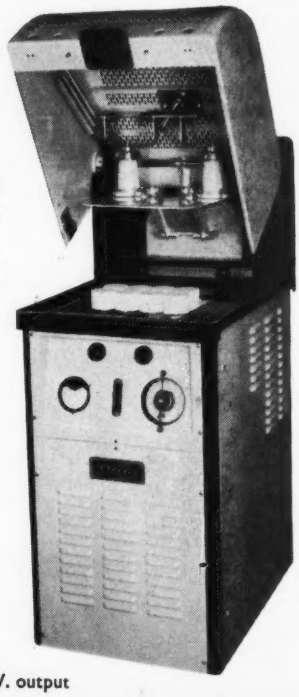

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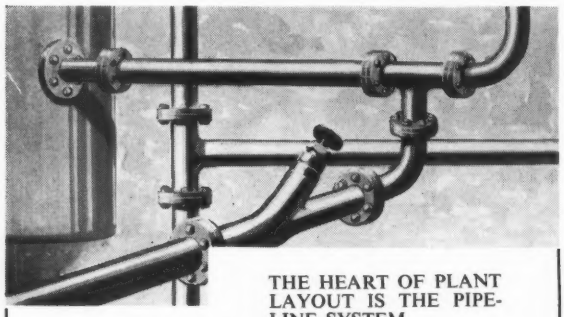

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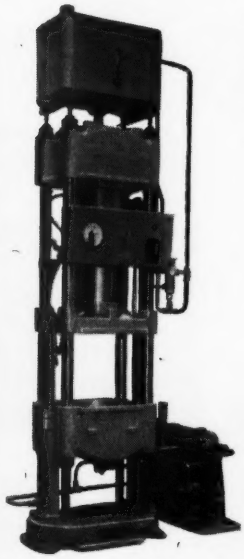

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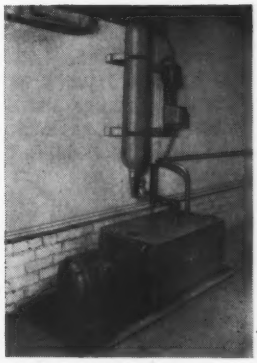

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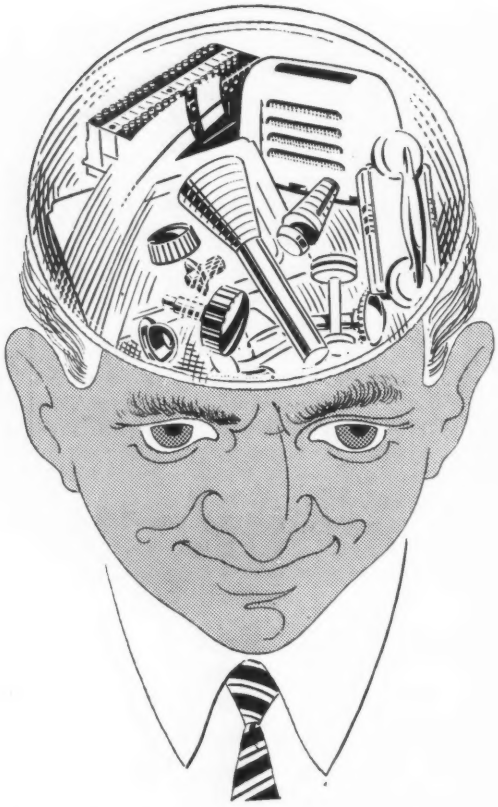

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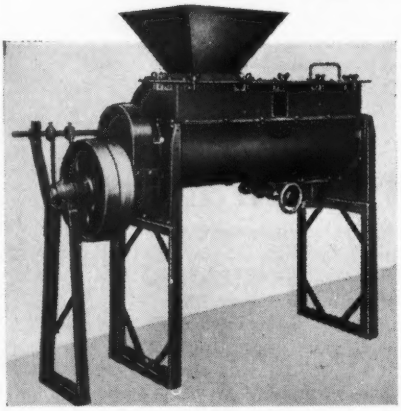

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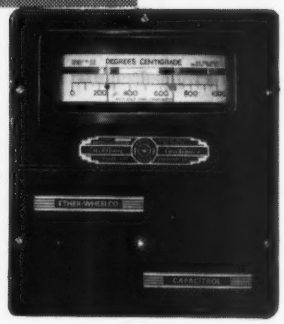

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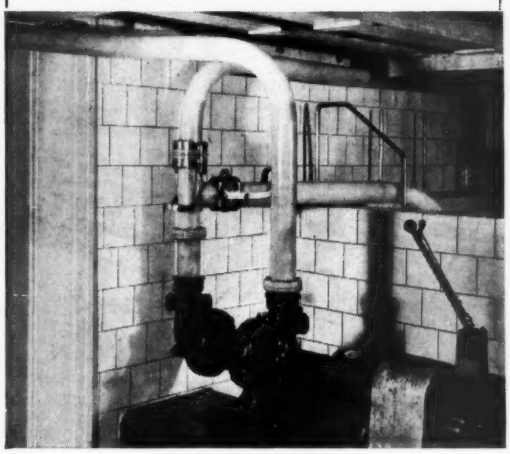

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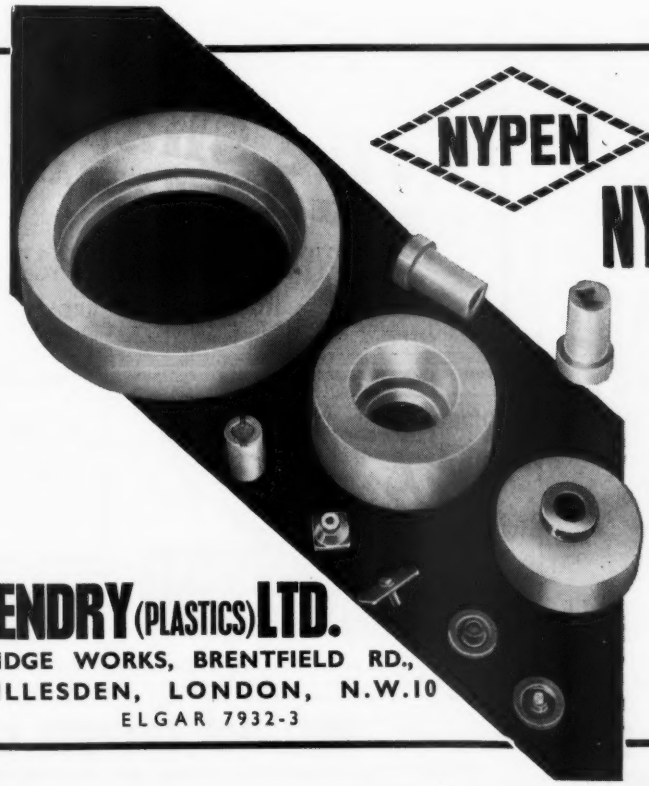

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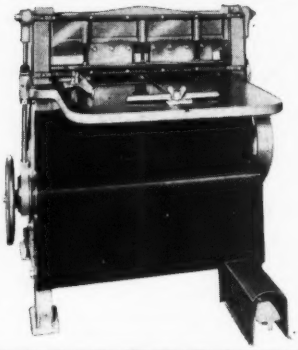

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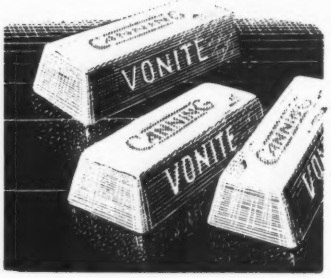

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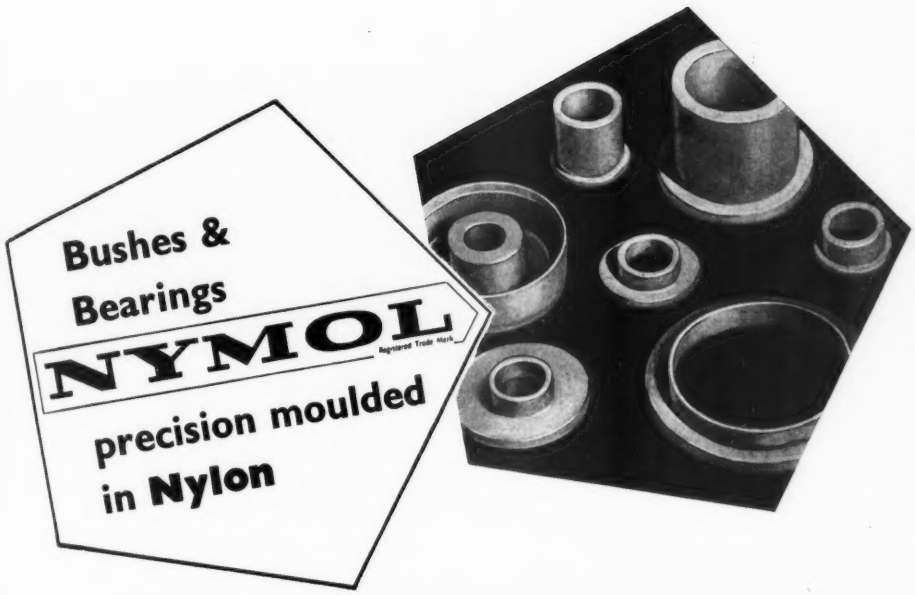

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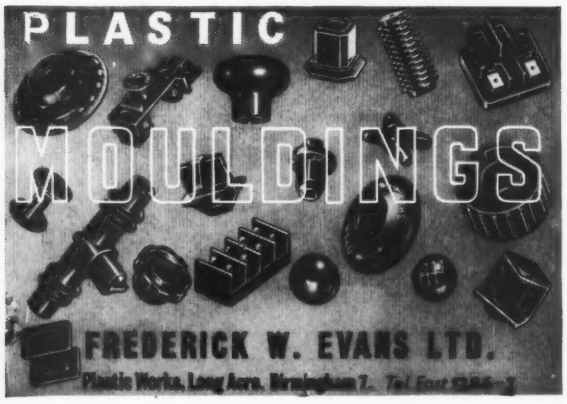

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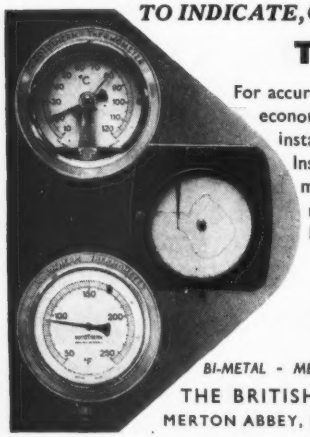

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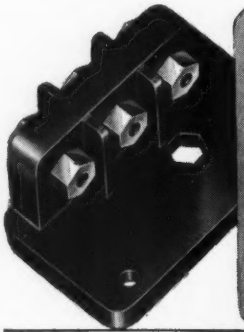

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Last-minute additions and deletions are accepted by telephone from trade advertisers up to noon. Advertisements received too late for a particular issue are automatically inserted in the succeeding one unless instructions to the contrary are received.

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SEEING IS BELIEVING!!! Make a point to see our new powerful motorized dust, fume extractor-blower units at new low price (£23). Everyone doing so, is most impressed. Bellangers, 306 Holloway Rd., London, N.7. North 4117. 216-1119

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COMPLETE GRINDING PLANT, comprising 54 in. by 16 in. Hardinge nickel chrome lined ball mill, vee rope driven from motor, complete with ball charge, air classifier, feeder, hoppers, and bag filter.
Apply: George Cohen Sons and Co., Ltd., 58 Wood Lane, W.12. phone, She 2070 and Stanningley, nr. Leeds. Phone, Pudsey 2241. 214-3

NEW EDWARDS VACUUM FORMING V.F2 MACHINE, unused, £340, immediately available. Invicta Plastics, Ltd., Queens Rd., Leicester. Phone 78935. 214-7

MACHINERY. 50-ton Turner plastics compression-moulding press, heated platens, etc., cost £800, little used, will accept £380. Also light-coloured moulding powder at 70 per cent. cost. Invicta Plastics, Ltd., Queens Rd., Leicester. Phone 78935. 214-6

PLASTICS MACHINERY.
Hydraulic Presses of all sizes. Injection Machines, Extruders. Mixing Mills. Hydraulic Pumps and Accumulators.
Send your requirements to the specialists.
REED BROTHERS (ENGINEERING), LTD.,
REPLANT WORKS,
CUBA STREET, MILLWALL, E.14.
Phone, East 4081 (five lines). 214-13

FOR SALE, surplus to requirements 15 15-in. square, three 20-in. square electrically heated platens and Cambridge controlling instruments, excellent condition, offers to Box P149, care of "Plastics." 214-21

MACHINERY, TOOLS AND PLANT WANTED

COMPRESSION AND INJECTION-MOULDING TOOLS WANTED. Send details of your surplus, obsolete and redundant moulding tools. Box P1311, care of "Plastics." 218-1129

WANTED URGENTLY, pair Daniels upstroke hydraulic presses, 42 tons; three Daniels 50-ton downstroke presses, with prefil; one Daniels 100-ton downstroke hydraulic press, with prefil. Box P1416, care of "Plastics." 214-43

Machinery, Tools and Plant (contd.)

WANTED URGENTLY, Sturtevant size 1 and 2 batch powder mixers. Box P1415, care of "Plastics." 214-44

INJECTION MOULDING MACHINES required. Condition or size not important. Send details. Box P0814, care of "Plastics." 219-1138

PLASTICS EXTRUDER to produce P.V.C. sheet 42-in. wide by ⅛-in. thick, preferably with angle head extruding downwards. Box P1414, care of "Plastics." 214-27

INJECTION-MOULDING MACHINES required. Condition or size not important. Send details. Box P0814, care of "Plastics." 214-9

MISCELLANEOUS

EXTEND YOUR TRADE.
Use a trade mark. Consult
Trade Mark Protection Society,
12 Church St., Liverpool. zzz-478

MOULDS

DOLL MOULDS FOR HIRE.
10-in., 12-in., 18-in., 25-in. baby and girl dolls with sleeping eyes. Injection moulders and dolls manufacturers please write to: Holloway Dolls (London), Ltd., 27 Church Crescent, London, N.20. 215-1124

7-IN. COMB MOULD FOR SALE, two impressions, suit Peco or T.M.A. machine, £150; perfect condition. Box P1433, care of "Plastics." 214-x1761

PATENTS

PATENT APPLICANT PLASTIC INJECTION MACHINE. Would demonstrate prototype to interested manufacturers, by appointment. Box P1219, care of "Plastics." 214-1122

THE PROPRIETORS OF BRITISH PATENT NO. 647,045, which relates to a method of bonding the abutting edges of material, are desirous of exploiting the invention by way of licence or sale. Inquiries should be addressed to Andrews and Byrne, 201 Bank Chambers, 329 High Holborn, London, W.C.1. 214-1

PRODUCTION CAPACITY

POLYSTYRENE AND CELLULOSE ACETATE INJECTION MOULDINGS up to 2 oz. Reliable service. Latest-type machines. Keen co-operation on new lines. W. H. Adamson Plastics, 39 Hedley St., Maidstone. 219-1132

SLITTING AND REWINDING OF PLASTIC SHEETING, film, paper, etc., to any width. Prompt service. Nathaniel Lloyd and Co., Ltd., Burrell St. Works, London, S.E.1. 216-1133

INJECTION MOULDING CAPACITY available up to 4 oz. Keenest quotations, prompt deliveries. Fully automatic plant. Rees Plastics, Ltd., 287 Liverpool Rd., London, N.1. Nor 4310. zzz-501

KINGSTON PLASTICS, LTD., Unity Works, Union St., Kingston-on-Thames. Manufacturers of virgin and second-grade cellulose acetate moulding powders, matched to customer's own requirements for colour and flow. Customer's own waste also reprocessed to specified requirements. Sorting and grinding, incorporating magnetic separation of metallic particles of all thermoplastics undertaken. Phone, Kingston 8405. 219-1139

VISIJAR LABORATORIES, LTD.,
THE LEADING CRAFTSMEN IN
"PERSPEX"
PROTOTYPE AND REPETITION,
OFFICIAL I.C.I. STOCKISTS "PERSPEX"
SHEET, TUBE, ROD.
STOCKISTS AND FABRICATORS OF "FORMICA."
149 LONDON ROAD, CROYDON, SURREY.
Phone, Croydon 8228 (two lines). zzz-492

INJECTION MOULDINGS by I.O.G. Industries, Ltd., 41 Marshgate Lane, Stratford, E.15. Maryland 2804. 220-1094

Production Capacity (contd.)

VACUUM MOULDERS invite trade inquiries for vacuum-formed articles, moulded in p.v.c., styrene, cellulose acetate, etc. Maximum mould size 36 in. by 36 in. Write Box P098, care of " Plastics." 217-1112

PLASTICS (MANCHESTER), LTD.,
BRITAIN'S LEADING STOCKISTS AND DISTRIBUTORS.
SPECIALISTS IN
FABRICATION, INJECTION MOULDING AND ENGRAVING.
11 WHITWORTH STREET,
MANCHESTER, 1.
Central 7081-2 and Central 1000. zzz-493

PULVERIZING, grinding and chipping to the trade. L. Lipton, Ltd., Lamprell St., Bow, E.3. Adv 3345. 214-1113

ELCO PLASTICS, LTD.,
HIGH WYCOMBE,
BUCKS.
A.I.D. APPROVED.
MOULDERS, INJECTION, COMPRESSION,
TRANSFER, SIDE RAM.
HIGH WYCOMBE 1921-2. zzz-498

REPETITION in Ebonite, Erinoid, etc. Capstan lathe work. Temple St., Rugby. Phone 4059. 223-1118

DINES PRODUCTS, Whitehall Lane, Grays, Essex, for injection mouldings. 223-1120

TUBE LAMINATION AND ENGINEERING, LTD.,
HIGH WYCOMBE,
BUCKS.
MAKERS OF S.R.B.P. TUBE " LAMTUF."
LIGHT ENGINEERS.
HIGH WYCOMBE 1921-2. zzz-499

SHORT RUNS A SPECIALITY: LONG RUNS A PLEASURE. Low mould cost and overheads. Injection capacity and technical knowledge at your service. Westminster Plastics, Temple Works, 41 Old Church Rd., Chingford, E.4. Silverthorn 7927. 223-1121

INJECTION MOULDINGS
AND
PLASTIC COVERING
IN ACETATE ALKATHENE, P.V.C.,
POLYSTYRENE AND DIAKON.
MACHINED PARTS IN BRASS, STEEL AND PLASTICS.
We solicit your inquiries.
F. A. KETCH AND SON, LTD.,
TRENT VALLEY WORKS,
LICHFIELD, STAFFS.
Phone, 3591 and 3592. zzz-500

CHIPPING OF PLASTICS AND GRINDING, screening, mixing and drying of all raw materials undertaken for the trade. Crack Pulverizing Mills, Ltd., Plantation House, London, E.C.3. Man 4405. zzz-487

INJECTION MOULDINGS IN THERMO-PLASTICS. Moulding in styrene, acrylics and acetate. Design and toolroom facilities available for mould construction. Inquiries invited. J. and E. Courtenay, Ltd., 138 Stratford Rd., Birmingham, 11. 214-1093

RAW MATERIAL

PERSPEX! PERSPEX!! PERSPEX!!! Official stockists for I.C.I. acrylic sheets. Sheets cut to your requirements. Fabrication and mounting specialists to the trade:—
S. C. Errington (Hanwell), Ltd., 132a Uxbridge Rd., Hanwell, London, W.7. Phone, Ealing 5288. zzz-40

Raw Material (contd.)

INJECTION-MOULDING MACHINES, three Westminster hand-operated for 10 gs. shots, surplus for sale. Box P1430, care of " Plastics." 214-30

POLYTHENE FILM SCRAP, very clean, regularly in ton lots for disposal. Please ask for particulars. Box P1428, care of " Plastics." 214-29

ALWAYS LARGE STOCKS OF
CASEIN
RODS, TUBES AND SHEETS,
PERSPEX
SHEETS UP TO 1 IN. THICK.
CELLULOSE ACETATE
CATALIN RODS.
S.R. (PLASTICS), LTD.,
93 ALDERSGATE STREET, E.C.1.
Phone, Monarch 4686. 221-1103

BRIGHT GREEN, toy colour, virgin cellulose acetate moulding powder for sale. Apply, Box P1317, care of " Plastics." 214-1130

PLASTICS (MANCHESTER), LIMITED,
BRITAIN'S LEADING STOCKISTS
OF
PERSPEX SHEET, ROD, TUBE.
11 WHITWORTH STREET,
MANCHESTER, 1.
Central 7081-2 and 1000. zzz-494

BLACK ACETATE SHEETS AND BLOCKS available for disposal. Apply Box P1411, care of " Plastics." 214-20

BLACK CELLULOSE ACETATE MOULDING POWDER. We can always supply first-grade at 2s. per lb., any quantity. Box P008, care of " Plastics." 214-16

FOR HOME AND EXPORT MARKET. We sell at low prices all plastic scraps, Acetate, Polystyrene, Alkathene, reground powders and reconditioned powders. Apply to Box P009, care of " Plastics." 214-15

CUEX, LTD., can offer all at prices well below current list:—
Polystyrene.
Cellulose acetate.
Polyethylene.
P.V.C.
Polyvinyl butyral.
Perspex and Diakon.
Send now for details.
Cuex, Ltd., 270 Corporation St., Birmingham. Central 5474. 214-17

RAW MATERIAL WANTED

WANTED, Polythene scrap. Write to Box P7416, care of " Plastics." zzz-0322

SURPLUS STOCKS of thermosetting and thermoplastic moulding powders wanted. Send details Box P056, care of "Plastics." zzz-481

ERLANOS, LTD., 93 Aldersgate St., E.C. (Monarch 4686), require Perspex and cellulose offcuts and scrap, clear and coloured, highest prices paid. 217-1079

P.V.C. GARMENT AND HANDBAG OFFCUTS wanted. We collect and pay cash. Brockwell Plastics, Ltd., 50 Hollingbourne Rd., S.E.24. zzz-490

SCRAP.
WE BUY
ALL THERMO-PLASTICS. REJECTED MOULDED PIECES. OBSOLETE MOULDING POWDERS, LUMPS, SPRUES AND RUNNERS.
AND PAY HIGHEST PRICES.
J. W. NASH AND CO., LTD.,
27 BEETHOVEN STREET, W.10.
Ladbroke 4655. 214-14

PROMPT CASH OFFERED for virgin and reprocessed cellulose acetate and polystyrene. Give manufacturer's name and backing. Box P873, care of " Plastics." zzz-491

RAW MATERIALS wanted. Polystyrene, polythene, C.A., P.V.C., Diakon, reject moulds, sprues, runners, lumps, etc. Highest price paid. Prompt payment. Also spot lot origin. Box P1020, care of " Plastics." 222-1106

WANTED, large regular supplies of nylon scrap shaving. Hugh Kershaw, Oxenhope, Keighley. 214-1123

ACETATE SCRAP, injection-moulding scrap and sheeting scrap in light colours, large quantities urgently required. Offers with samples to Box P1426, care of " Plastics." 214-28

POLYSTYRENE AND POLYTHENE, any quantities of new material, scrap, nozzle lumps, etc., urgently wanted. Please offer with samples to Herbert Connor, Ltd., 120 Beaufort Park, Falloden Way, London, N.W.11. 214-31

Raw Material (contd.)

RAW MATERIALS wanted. Polystyrene, polythene, C.A., P.V.C., Diakon, reject moulds, sprues, runners, lumps, etc. Highest prices paid. Prompt payment. Also spot lot origin. Box P1020, care of " Plastics." 214-1111

SITUATIONS VACANT

The engagement of persons answering advertisements in respect of vacant situations must be made through a local office of the Ministry of Labour, or a scheduled employment agency, if the applicant is a man between the ages of 18 and 64 inclusive or a woman beween the ages of 18 and 59 inclusive, unless he or she, or the employment, is excepted from the provisions of Notification of Vacancies Order, 1952

REINFORCED PLASTICS DEPARTMENT in modern factory in South Wales requires an experienced Plastics Technician, preferably with engineering background, with some training and an adventurous outlook, to head up new production development section. Ample scope for future advancement in this interesting new branch of the plastics industry. Please give full details of experience and salary desired to Box P1425, care of " Plastics." 214-34

ATTRACTIVE OPENING EXISTS at our South Wales factory for an experienced Plastics Engineer, who will be expected to deal successfully with production problems in connection with glass reinforced plastics. Practical experience of plastics moulding, combined with a sound engineering background, are essential qualifications for this position. Good salary and prospects. Apply with full details of experience and salary required to Box P1424, care of " Plastics." 214-35

PLASTICS TECHNOLOGIST required to take charge of production development of glass reinforced laminates in newly formed section of established Company in South Wales. Ample scope for resourceful and energetic man preferably with an engineering background but particularly with general knowledge of plastics manufacturing techniques. Salary commensurate with responsibility and experience. Details of experience and salary required to Box P1423, care of " Plastics." 214-36

EXTRUSION OPERATOR.
LARGE AMERICAN CUSTOM EXTRUSION HOUSE LOOKING FOR EXPERIENCED MAN TO ASSIST PLANT SUPERVISOR IN EXTRUSION SET UP, DIE DESIGN, ETC.
MUST HAVE EXPERIENCE IN THE EXTRUSION OF ONE OR MORE OF THE FOLLOWING MATERIALS: CELLULOSICS, ACRYLIC, STYRENE, POLYETHYLENE AND NYLON.
WILL HELP RE-LOCATE RIGHT MAN. BOX P1335, CARE OF " PLASTICS." 215-42

COLOUR MATCHER required for Plastics laboratory in Hertfordshire, must have some practical experience. Salary from £500 per annum according to qualifications. Box P1422, care of " Plastics." 214-37

FOREMAN required with experience in the production of fibreglass laminates and vacuum moulding, should be capable to train staff and supervise entire production. Hendon area. Good prospects for suitable man.
Write stating age, experience and wage required. Box P1421, care of " Plastics." 214-38

AN OPPORTUNITY OCCURS for an enterprising young chemist to share in intensive development work on glass-reinforced plastics. Excellent working conditions at N.W. London laboratories, canteen, etc. Ample opportunities for advancement in expanding industrial organisation. Salary according to qualifications and experience.
Apply giving full details, with salary expected, to Box P1420, care of " Plastics." 214-39

MALE CLERICAL SALES ASSISTANT, preferably under 30, required by American subsidiary company in Park Lane. Pension and free Life Assurance. 5-day week. Write stating age, experience and salary required to Box P1418, care of " Plastics." 214-41

WE ARE LOOKING for a bench-hand with practical experience in the manipulation of P.V.C. Sheet Tube for our Plastics Department. The position offers considerable scope for advancement to the right type of individual. Applications should be made to the Works Manager, EGA Electric, Ltd., Holyhead Road, Wednesbury, stating age, wage required and experience. 215-1137

CHEMICAL ENGINEER required. Must have sound knowledge of plastic materials, with engineering ability, for firm of extruder manufacturers. Write giving full details in confidence as to experience, salary required, etc., to Bone Brothers, Ltd., Manor Farm Rd., Alperton, Wembley. 214-x1458

DEPARTMENTAL MANAGER with knowledge of vacuum-forming technique required by well-known plastics company in Midlands. The position offers wide scope to suitable applicant. Non-contributory pension scheme. Applications giving full particulars should be addressed in strict confidence to Box P147, care of " Plastics." 215-1136

Situations Vacant (contd.)

DRAUGHTSMEN required with experience in mould design, jigs and fixtures preferred but not essential. Good conditions; canteen and social club facilities. Please apply Injection Moulders, Ltd., Westmoreland Rd., N.W.9. 214-x946

THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY,
ALDERMASTON, BERKS,
REQUIRES A CHEMIST
IN THE GRADE OF
EXPERIMENTAL OFFICER
TO WORK IN THE MATERIALS FIELD,
I.E., PLASTICS, ADHESIVES, ETC.

Duties include advisory service in the plastics and adhesives field, and development work with new materials is also involved.

The minimum qualification is Higher National Certificate in Chemistry—candidates being not less than 26 years of age—but a B.Sc. Pass degree or A.R.I.C. is preferable.

A good fundamental knowledge of the high polymer field is required, together with practical experience of resins generally extended over a number of years. Salary: £775-£945 per annum (male). The successful applicant will be required to join the Authority's contributory superannuation scheme.

Housing accommodation will be available within a reasonable period for married staff who live outside the radius of the Establishment's transport facilities or, alternatively, the Authority may be able to assist the successful candidate in the purchase of a house. During this period a lodging allowance may be payable.

SEND POSTCARD FOR APPLICATION FORM TO:
SENIOR RECRUITMENT OFFICE,
A.W.R.E. ALDERMASTON, BERKS.
Quote ref. 597/WGE/144. 214-5

SALES ASSISTANT required for extrusion machine sales division of well-known plastics machinery manufacturers in West of England. Must have good knowledge of extrusion process and be able to advise prospective customers. Good prospects for energetic and qualified man. Apply first in writing to Box P144, care of "Plastics." 214-24

ASSISTANT aged 21 to 40 years required for laboratory and experimental department, mainly on plastics-injection, extrusion and thermoset. Minimum standard, National Certificate—preferably in chemistry; or Degree Physicist. Good prospects for keen and energetic man. Apply in writing to T. H. and J. Daniels, Ltd., Stroud, Glos. 214-25

TECHNICAL REPRESENTATIVE required to develop chemical sales to the vinyl resin industry. B.Sc. or equivalent with some experience on commercial side and enthusiasm for sales development, excellent opportunity for right man with initiative and ability. Pension and profits sharing schemes.

Write full details age, qualifications, experience to date and salary desired to Ref. TVR, Box No. 8504, care of Charles Barker and Sons, Ltd., 31 Budge Row, London, E.C.4. 214-1131

EXPERIENCED PRODUCTION MANAGER required to take charge of and develop small moulding shop with prospects of rapid expansion in technical products. Mechanical knowledge essential, some commercial experience advantageous. Box P138, care of "Plastics." 214-1127

Situations Vacant (contd.)

A GOOD OPPORTUNITY EXISTS for experienced plastics chemist with highly reputed old-established company wishing to develop in this field. Reply, stating qualifications and remuneration, to Box P137, care of "Plastics." 214-1126

CHEMISTS, under 30, with degree or equivalent qualification, preferably with experience in plastics, required for development work in industrial laboratories in Birmingham. Box P1310, care of "Plastics." 214-1128

REQUIRED, an experienced man, capable of taking charge of compression moulding shop; permanent and well-paid position. Apply "Seaforth," Watchett Works, Oakhurst Rd., Southend-on-Sea. 214-1125

BECK KOLLER AND CO., LTD., SPEKE, LIVERPOOL, 19, manufacturers of Filabond polyester resins for glass-fibre reinforced plastics, have a vacancy in their Technical Service Laboratory for a demonstrator.

Applicants may be required to visit customers to demonstrate hot and cold laminating on a commercial scale.

Write, giving details of experience and salary required, to the Technical Director. 214-4

ASSISTANT CHEMIST required for control and development work on U.F. resins, moulding powder and p.v.c. extrusion materials. Minimum standard intermediate B.Sc. or equivalent. Applicant should have completed military service. Salary £500 upwards, depending on qualifications and experience.

Apply in writing to Chief Chemist, Lacrinoid Products, Ltd., Gidea Park, Essex. 214-8

CHEMIST of graduate or A.R.I.C. standard required to take charge of testing and process control laboratory. The successful applicant will, after an introduction period, be engaged on individual work of a varied and interesting nature.

Apply Personnel Manager, B.X. Plastics, Ltd., Higham Station Avenue, E.4. 214-11

LABORATORY ASSISTANT required for chemical and physical testing in connection with plastics production. Experience not necessary providing applicant has a general certificate of education and has a chemistry and physics at advanced level.

Apply Personnel Manager, B.X. Plastics, Ltd., Higham Station Avenue, E.4. 214-10

INDUSTRIOUS AND RESOURCEFUL MAN required to take charge of development and production in expanding manufacturing organization in South Sweden, age not above 35, scientific education to degree or A.I.R.I. standard and experience in rubber and plastics technology essential, knowledge of German an advantage, good prospects of remunerative and interesting career in a country with a high standard of living and a temperate climate. Apply in first instance, giving details of education, experience and equivalent salary required, to Box P142, care of "Plastics," 214-26

TIME STUDY/METHODS ENGINEER required for a factory manufacturing wood and plastic products, London area. Good salary and prospects for keen man.

Write full details of past experience in confidence to Box P1417, care of "Plastics." 214-42

MANAGER OF HARD TILE DEPARTMENT with a knowledge of thermoplastic tile production, required by well-known progressive company in Midlands. Position offers wide scope to suitable applicant. Non-contributory pension scheme in operation.

Apply in strict confidence to Box P148, care of "Plastics." 214-22

Situations Vacant (contd.)

WORKS MANAGER required for small fabricating factory, E. London area. Knowledge of thermoplastics essential, and must be good organizer. An opportunity to be "in on the ground floor." Apply in confidence to managing director, giving experience and salary required. Box P1413, care of "Plastics." 214-18

TOOLMAKER/MAINTENANCE FOREMAN required for progressive factory in Colombia, South America, using Daniels presses and specializing button manufacture. Factory pleasantly situated in country approximately 15 miles from capital, ideal climate, British rates of pay, no income tax. Further details Box P145, care of "Plastics." 214-23

SITUATIONS WANTED

ESTIMATOR SEEKS POSITION as technical sales representative. Good commercial background and sound knowledge of compression and injection mouldings and materials and their applications in industry. Conscientious and reliable. Box P1432, care of "Plastics." 214-x1859

VERSATILE MODELLER, designer and technician seeks contact with firm interested in giving scope to experienced man keen to develop vacuum forming. Box P1431, care of "Plastics." 214-x1677

A DISCRIMINATING PRINCIPAL, seeking administrative support and a vigorous attack upon his production problems, may avail himself of the services of a chemist-chemical engineer by writing in the strictest confidence to the box number cited below. The advertiser, after some 25 years of a widely varied career, including consultancy, in factory and general management, can dispose of exceptionally mature technological and organizing experience allied to a fund of commercial acumen, and a "flair" for leadership.

Knowledgeable in P.V.C., colours, oils, fabric-coating, paper, adhesives, pharmaceuticals, metals, etc., but ability to grasp essentials quickly in any sphere a major asset.

His present appointment being the likely target of enforced economies, it could be to mutual advantage to discuss his future. Write, please, to Box P1427, care of "Plastics." 214-33

CAPABLE PRODUCTION ENGINEER (28) H.N.C., wide experience of injection and compression, seeks position as assistant product manager or similar post. Box P141, care of "Plastics." 214-x1589

TIME RECORDERS

FACTORY TIME RECORDERS, Service rental. Phone, Hop 2230. Time Recorder Supply and Maintenance Co., Ltd., 157-158 Borough High St., S.E.1. 221-1102

WANTED

WANTED, quantities of small plastic racing cars, ¾ in. by ⅜ in. by ¼ in. approx. Offers to Box P1412, care of "Plastics." 214-19

BOOKS AND PUBLICATIONS

THE THEORY OF POLYMERIZATION, by H. R. Fleck, M.Sc., F.R.I.C. Full examination in simple language with examples, calculations and exercises of this fundamental aspect of the chemistry of plastics. Illustrated, 144 pages. 10s. 6d. net from booksellers, or 11s. by post from the publishers, Temple Press Ltd., Bowling Green Lane, London, E.C.1. zzz

PLASTICS, SCIENTIFIC AND TECHNOLOGICAL (3rd edition), by H. R. Fleck, M.Sc., F.R.I.C. A completely revised edition of a recognized standard work on the chemistry and technology of plastics. ". . . should be in every technical library."—Times Review of Industry. Illustrated. 400 pages, 40s. net from booksellers, or 40s. 9d. by post from the publishers, Temple Press Ltd., Bowling Green Lane, London, E.C.1. zzz

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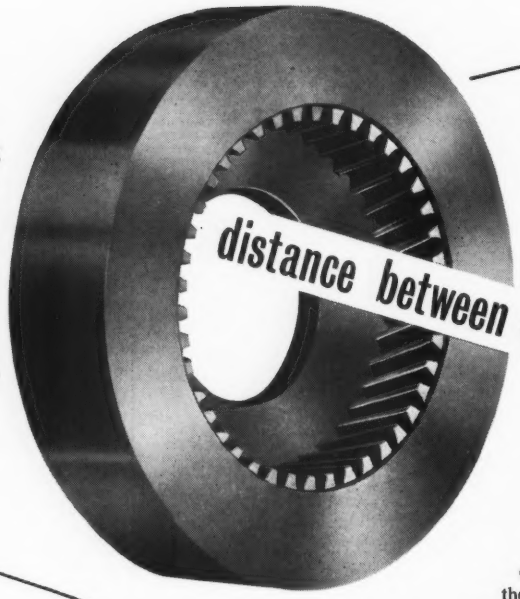
The shortest

HARD NICKEL ELECTRO-FORMED DIES



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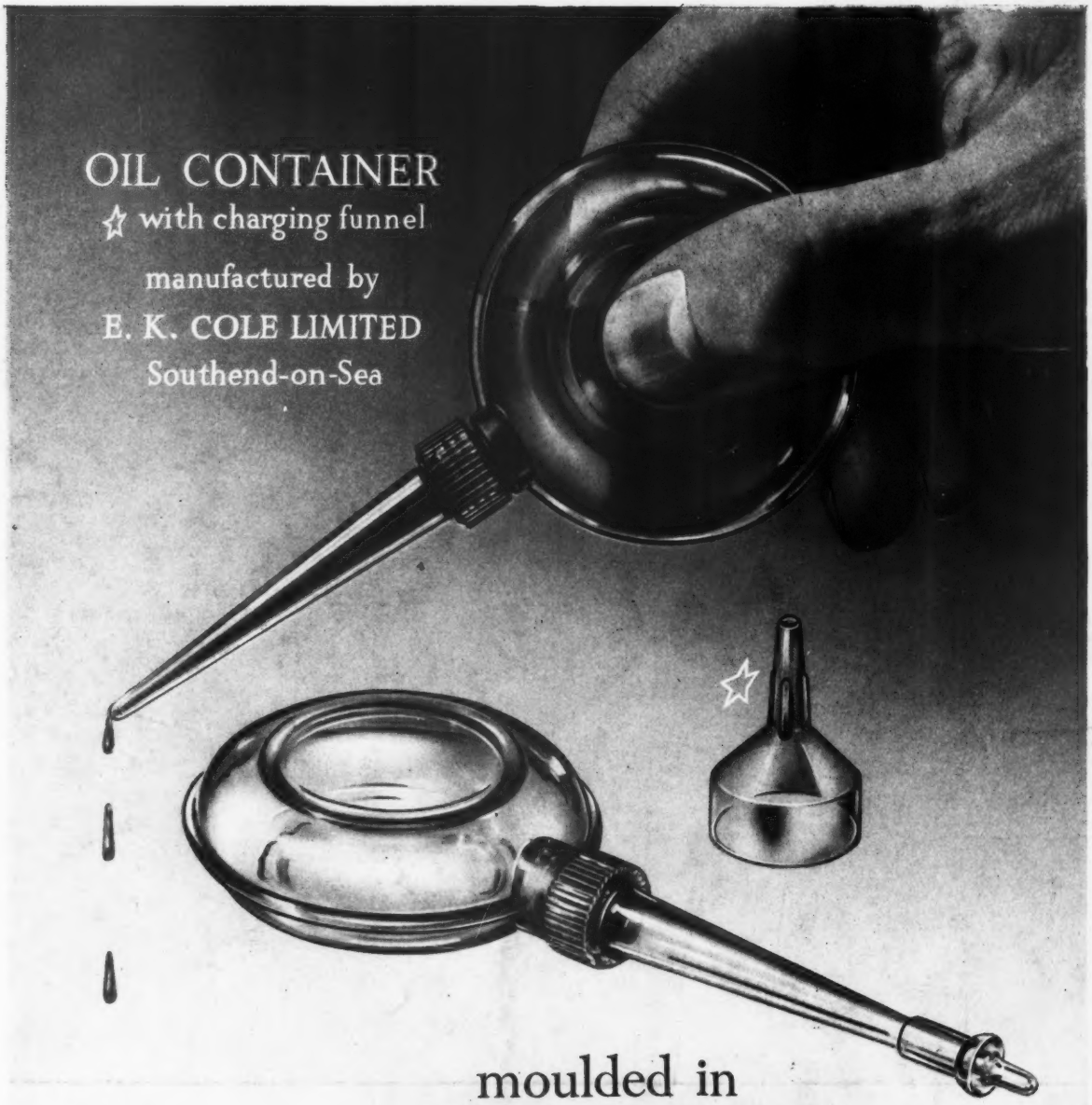

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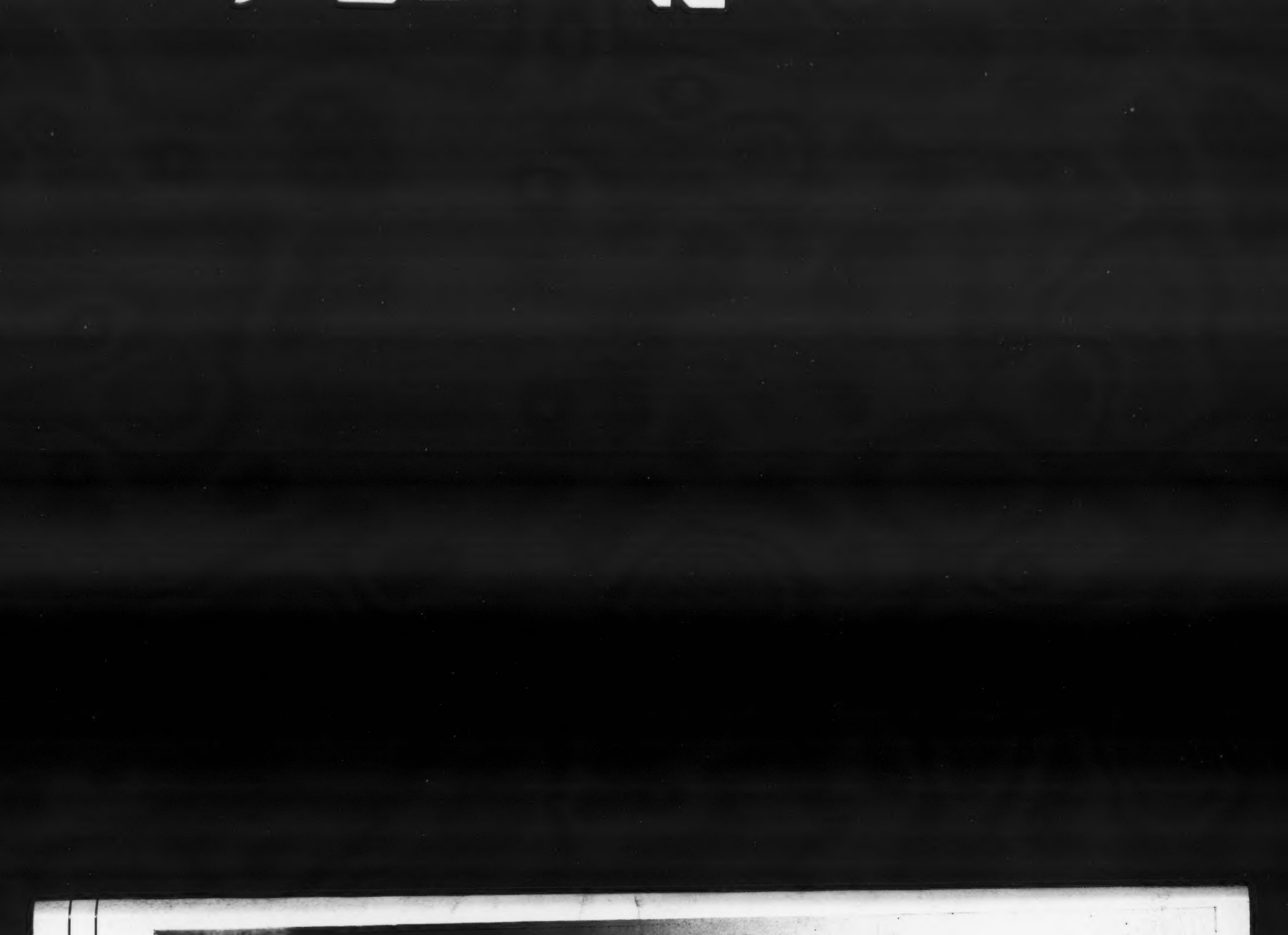
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